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PRACTICAL ESSAYS.

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BY

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P R E F A C E.

The term of *Practical Essays* has been given to these, to distinguish them from the volume of papers, reprinted by the Author from the Transactions of the Royal Societies of London and Edinburgh.

The Author has entertained the belief, that a member of a University should watch the current opinions on the subject he teaches, and endeavour to check the wrong bias which fashion and accident are continually giving to Medical Studies, to the neglect of sound doctrine, and of approved authorities. If this be granted, no further apology will be necessary for these occasional Essays.

The professional friends who shall peruse these pages, will acknowledge that they treat of subjects of much difficulty, but embracing questions of practical importance; and they will not regret that their attention has been solicited to them.

AINSLIE PLACE,
1st *February* 1841.

PRACTICAL ESSAYS.



ESSAY I.

ON THE POWERS OF LIFE TO SUSTAIN SURGICAL OPERATIONS
THE EFFECTS OF VIOLENCE IN WOUNDS AND IN OPERA-
TIONS: AND THE CAUSES OF SUDDEN DEATH DURING SUR-
GICAL OPERATIONS IN SOME REMARKABLE INSTANCES.

THIS subject has been pressed on the author's attention by death occurring during operations with such appalling suddenness, that, before the operator could turn round, sense and motion had ceased. Such cases, though happily rare, demand examination, and ought to lead to a general survey of the causes of death. In importance it yields to no other question, and needs no apology.

The conviction comes tardily on the surgeon's mind, that there is a limit to his boldness and ingenuity in operating on the living body; hence it is that surgeons of experience refuse to do those feats which they were eager to perform in their younger days.

A change has taken place in the mode of education of surgeons since the time when Mr John Bell made his eloquent appeals to enforce the study of surgical anatomy. In this respect all has been attained, but there may be an error the other way. The young surgeon, by exercise in anatomy, acquires a workman's feeling of his subject, that every thing may be accomplished by dexterity; and he engages in operations which the powers of life cannot sustain.

Before treating of the main subject, which is death from the admission of air into the circulating system, I shall notice some of the more common causes of death, that we may be the better able to judge of the force of the objections which have been made to the possibility of this occurrence.

We cannot do better than take the method of Cullen, and consider the "direct" and the "indirect" causes of death; that is, the influences which act immediately on the nervous system, and those which destroy the organization necessary to the support of nervous excitement.

Syncope, or deliquium, seldom takes place during an operation. It is more frequent after it, when the patient is assured that the pain and danger are over. It is then an influence of the mind, as in fright and sudden joy, which suspends the heart's full action,

and diminishes the force of circulation in the brain. Originating in the brain, the cause happily ceases with the insensibility, and the patient revives. When there has been great loss of blood, fainting may be succeeded by death. The expression in common parlance for this sudden death is collapse,—a term once familiar to the learned, but then, as now, unintelligible; unless it means the action of the heart on an insufficient supply of blood [*anæmiasis*]. In effect this is equivalent to debility of the heart itself [*asthenia*, abatement], and both these causes combining make hæmorrhage in the dropsical and chlorotic very dangerous,—they faint and do not recover. I need hardly say, that to procure fainting, in order to save the infliction of pain during an operation, is unwarrantable. If the pain of the operation does not rouse the sufferer to consciousness, what will?

Severe and long continued surgical operations may be attended with fainting, as torture and grievous wounds are. We witness this in the reduction of dislocations; there is, however, in such cases, something peculiar in the nature of the pain, or rather in the part which suffers.

Death may be caused by direct injury to the nervous system. A severe blow on the stomach kills instantly. If a man, having fallen from a height, be

brought into the hospital dead, and there is neither rupture of a viscus nor injury of the head, he may have suffered from the general shock, as you kill an eel ; or it may have happened, that he has struck the stomach against something in his descent, as I had, in one instance, reason to believe had taken place. We supposed that the man had, in his descent, been doubled over the iron of a lamp.

A blow on the throat has proved suddenly fatal. In this case, I believe that, as in the instance of death from a blow on the stomach, the injury is propagated to the source of the respiratory nerves, and hence the sudden interruption to breathing and expression, as well as motion of the body.

I remember to have seen a patient brought into the operating theatre, and, being placed on the table, he was dead ! On inquiry, the case was peculiar and applicable. He had a shattered limb, and had suffered under tetanus. In this malady we may be deceived ; for, after severe suffering for two days, it is not unusual to have a report that he is better, because of the relaxation of the spasm, and the capacity of swallowing ; directly after which he sinks.

Fear of hæmorrhage has almost disappeared ; and certainly a well educated surgeon, in cases of operation, will not let his patient die of bleeding. It may be reasonably imagined, that the quantity of blood

lost, being obvious to sight, would render the symptoms attending that loss of little importance ; yet I have seen the surgeon greatly miscalculate the quantity of blood lost during an operation, and with fatal consequences. In internal hæmorrhage from deep wounds, from contusion, and bursting of the solid viscera, in uterine hæmorrhage, the symptoms are the only sources of alarm. When there is formidable bleeding during a protracted operation, the flow of blood stops, through exhaustion, to return in the evening ; and when the pulse rises and the patient becomes hot and restless, it may then prove fatal.

The loss of blood, in every case, is attended with great thirst ; there is an asthmatic sensation in the breast, which makes the patient sigh deeply ;* he becomes ashy pale ; the pupils are dilated ; his sight fails ; he is alarmed that he does not see his friend, and stares wildly ; his hands are abroad, if not restrained ; there is vertigo ; his pulse is weak and compressible. Often, convulsions precede death (a sign alarming to the accoucheur). If there be a slow draining of blood, it is attended with a low delirium.

* And so it is when an animal is purposely bled to death : When the carotid is opened, and after the first burst, the breathing becomes hurried and laborious—the eye becomes heavy, and, before death, there is a general convulsion of the frame.

The patient on the operating table has died from a rupture of the great artery. The heart and vessels are in great excitement, when a man braces his courage to submit to an operation. Sir Astley Cooper sent me the aorta of a man who died under the operation for popliteal aneurism ; and, if I remember right, the patient was carried out without the operation being completed.

If a limb be entangled in machinery and torn off ; if the knee-joint be crushed ; if a man receive the whole charge of a fowling-piece in his thigh, or has his limb carried off by a cannon shot, the effect will be immediate : he will be found pale, and cold, and without pulse ; the countenance haggard, and the expression wild ; and, in a low delirium, he sinks the same evening.

No one deserving the name of surgeon will place a patient on the operating table, when the respiration has partaken of this influence, and the chest rises high, or when the extremities are becoming cold ; for these are the indications of approaching death.

The result of a surgical operation, severe and too long protracted, is similar to that of a grievous wound ; as in lithotomy, when a large stone has caused difficulties and repeated unsuccessful efforts ; or the operation for *fistula in perineo* too long per-

severed in. It may be, that in cases of lithotomy, lithotrity, and fistula, the part operated on, more than the degree of suffering, is the cause of symptoms. In the operations on the urinary organs with violence, the kidney suffers : the secretion of urine is suppressed ; the urea, or a poison, circulates, and falls on the brain, and the patient becomes delirious, almost maniacal, in which state he dies. I have seen painful instances of the maniacal state from diseases of the urethra and bladder. The subject is now better understood, from the labours of Dr Bright, and is well touched upon by Professor Christison, in his work on the Granular Degeneration of the Kidneys.

But independently of the particular organ, we cannot witness great and protracted violence in surgical operations without apprehension that the powers of life will fail. When we see the limbs stiffened through agonizing pain ; the face turgid, and the eyes prominent and suffused ; when the patient faints through excess of suffering ; and when, though insensible, the frame is still convulsed with hysterical heaving of the breast ; when, roused by the continuance of the operation, he is incoherent, and touchingly speaks of something foreign to his actual state ; when the drink offered to him is forcibly ejected from his irritable stomach ; in these sad circumstances, we may say that the surgeon has been deceived, and that the

powers of life cannot sustain the injury, or that a chance of life is too dearly bought. The patient after the operation remains faint, and the pulse is not to be felt; he vomits; the stomach rejects drink; the pulse may rise, fluttering, to 160. He becomes restless, falls into a state of low delirium, is convulsed, and dies within twenty hours.

In noticing death from severity of suffering, whether from accident or in consequence of operation, we must mention another condition and very frequent instance of sudden death. An habitual drunkard has his thigh broken, or there is a bad compound fracture of the leg; he becomes delirious; the nature of his symptoms is misunderstood; to subdue the supposed inflammation, he is bled, and killed as by a shot.

To proceed with this fearful catalogue, we may look a little farther into the secondary and remote consequences of severe operations. The throbbing pulse, the hot and restless tossing of the succeeding night, may have been subdued; the secretions may be restored; antimonials and opiates may have been successful, and a hectic succeeded to the flush of inflammatory fever: but he has a dry cough,—a tightness of the chest; he breathes with a sense of oppression; these signs, in the circumstances, are alarming. The surgeon, regretting the loss of his patient,

remarks that, but for the accidental attack of inflammation in the lungs, his operation would have been successful. But this inflammation is not accidental ; the vulgar expression is as correct as science can suggest. The vascular excitement falls on the weak part.* In a violent inflammatory fever, the lungs, or liver, or kidney, being in a state of incipient disease, will have the general action concentrated upon them.

Connected with this subject, there is one but darkly comprehended as yet: the inflammation of veins from the effects of wounds and of surgical operations. This follows on amputation, for example, and the symptoms are, frequent rigors and a low fever, with general sinking of the strength ; with the pulse continuing at 130 or 140 in the minute. On death, abscesses are found in organs distinct from each other, and remote from the part in which the inflammation arose. Such collections of matter are not only found in the affected veins, but in the lungs and the liver, and remote joints ; and these abscesses in the lungs and the liver are unlike those consequent on pneumonia or hepatitis ; they are dispersed in different parts of the organs, are recent, and have no surrounding thickened walls.†

* The observation is in *Celsus*.

† This diverges into many other very important practical sub-

We now advance to a subject of the highest interest. During certain operations performed on the neck and shoulder, the patient has suddenly expired,—I may say, ceased to live. No word has escaped him, no sigh, nor convulsive motion. The operators, surprised at his quiescence, and regarding him, find that he is dead.

Critics have expressed their belief that these patients must have died of hæmorrhage; others that they must have died from the general shock to the nervous system. Dupuytren was accused of *amour propre*, his opponents alleging that he was desirous of accounting for his patients' death rather by some extraordinary and unlooked-for cause, than what might have been foreseen and guarded against. M. Roux, too, was criticised in the same manner by those, we may surely say, who could not have witnessed death from violence or from hæmorrhage; and the reader will now perceive why I have prefaced this subject by the statement of the more common occurrences succeeding operations, and causing rapid sinking of

jects; as those local affections produced by acute diseases. How many of the histories of our surgical cases commence with the acute diseases of youth. See *Dr Alison's Paper on Tubercles*; or *Sir James Clark on Consumption and Tuberculous Disease*. Read also *Mr Arnott's Paper, Med. Chir. Trans.* vol. xv.

the powers of life. Neither violence, nor loss of blood, nor even the bursting of the aorta, nor nervous influence, produce effects so sudden and appalling as this cessation of motion—as by a lightning stroke. That this catastrophe can be provided against, is another reason for entering on the inquiry.

On looking over my sketches of the wounded at Waterloo with the Baron Larrey, he fixed with interest on the case of a young man who had been wounded in the lower part of the neck. “Well I know,” says this excellent surgeon, “how that man must have died. I have seen many so wounded during my campaigns, and die from air drawn into the veins.”

The question was brought forward in 1822 by M. Dupuytren. He was operating on a tumour situated on the lateral and posterior part of the neck of a stout young woman. During the operation, and whilst an assistant raised the tumour, the operator heard a sound like the entrance of air into a void cavity: “If it were not that I am far from the air-tubes,” said Dupuytren, “I should have supposed that we had opened them.” The words were hardly spoken, when the girl said, “*Je suis morte :*” she trembled, and fell back without life!

In 1823, Delpech, having taken off the arm of a man of thirty years of age, found him thus suddenly dead. The arm was scarcely detached, when the man ceased to live, "*n'existoit plus.*" The thunderbolt could not have been more instantaneous in depriving the man of life.

In 1836, M. Roux, in removing the right arm of a man of fifty-three years of age, heard twice during the operation the noise of air drawn in. The operation was hardly completed, when he found that his patient had "ceased to live." The expression is particular, they do not see the man die, but find him dead.*

Dr Warren, professor of surgery in Harvard University, U. S., having wounded a branch of the vein joining the internal jugular, heard bubbles of air drawn in, and the patient fell insensible. (See his interesting volume on Tumours.)†

* "*Mais elle n'était pas achevée, que mon malade avait cessé de vivre.*"

† In the same volume, p. 260, we have a vein opened in the axilla in extirpating a gland. "A vein was divided and a small quantity of venous blood discharged. Scarcely was this done, when the patient struggled, her complexion changed to a livid colour, and, at the same instant, a bubbling or gurgling noise, which had not been noticed before, was heard, though indistinctly; but the place from which it issued was not visible, the surrounding skin and fat lying over it. On this, the axilla was immediately

It is unnecessary to multiply examples. Death has so occurred, and ought to have excited a livelier attention, for it is one of those subjects which, if followed up, will lead to matters if possible of greater interest.

How then is it that a man shall be thus cut off without a symptom, without a word uttered—without the distortion of a feature or the convulsion of a muscle, and this in such distressing circumstances as under the hands of a group of surgeons? It is ignorance to pooh! pooh! it down, and say that the patients die of hæmorrhage or of a shock to the nervous system, since we have seen that men do not die from these causes in that manner.

I can have no hesitation in joining my belief to that of others, who have accounted for such sudden

compressed. The patient became insensible, breathing as in apoplexy—Some brandy was poured down her throat, and ammonia introduced into the nostril. The pulse, however, became less distinct every instant. Clothes dipped in hot water were thrown over the extremities. Strong frictions were applied to the chest," &c. This patient survived, but, from this narrative, I am convinced the patient was saved by the surgeon knowing the nature of the accident, and immediately compressing the axilla. Again, page 182, in operating on the neck, the jugular vein was divided. "A few bubbles of air entered the open mouth of the vessel, but were arrested by the finger below, and forced back again." The same occurred in the practice of Dr Stevens of New York.

death, by supposing that air has entered the veins of the neck; for strange as it may at first appear that any thing so bland as atmospheric air should instantly terminate life, yet we know that it has this effect. I have long ago, with many others, ascertained, that blowing air into the veins has this effect on animals; and it is not an uncommon manner of killing horses.*

Still the question arises,—when a vein is opened, does not the blood flow? How should the air in such cases be drawn in? I must be allowed to say that in this investigation, neither the hydraulic law, nor the action of the muscles of the neck, have been sufficiently adverted to.

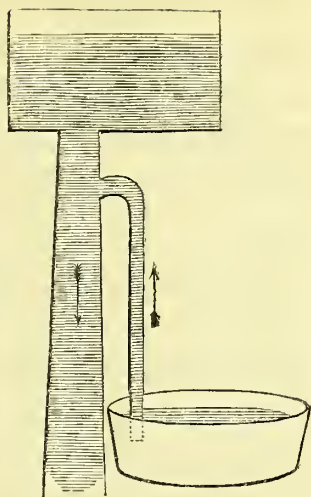
In the first place, this is an established fact: when water flows through a tube, the tube being gradually larger at its further extremity, and a lesser tube be inserted into it, water will not flow from the larger tube into the smaller, but from the smaller into the larger. This corresponds with the course of the blood in the veins: for the lesser veins are inserted into a series of trunks gradually enlarging in their diameters, till they reach the heart.

* The professor of veterinary surgery, Mr Dick, tells me that it just requires three times the discharge of his lungs blown into the veins to kill a horse.

In these circumstances, a hole in the side of the tube will not discharge water, but will admit air. But it will be very properly objected, that the veins of the neck not being rigid tubes, the hydraulic law does not apply.

I am now to shew that these veins of the neck are subject to a condition still more favourable to the admission of air, than if they were rigid tubes.

The opinion which has most prevailed, as to the mode in which the air enters, may be thus stated. It is supposed that the right auricle of the heart, in dilating, has the effect of producing a vacuum, and of thus sucking the blood into it from the veins: it is further conceived that, when a vein is opened within a certain distance of the heart, so as to be affected by the supposed suction produced by the auricle of the heart, then, air will be drawn into it. But I think it most probable, that the commissioners, deputed to make experiments on this subject,* re-



* By the Academy of Medicine of Paris.

moved, in their experiments, the very apparatus on which the phenomena really depend. They *exposed* the veins; thereby destroying altogether the effect of the action of 'the muscles of the neck upon them, which is to expand these vessels, situated beneath them.

The coats of the veins of the neck are remarkably delicate. Accordingly, if a vein or a gut, or any such tube, membranous and soft, be attached to the nozzle of a syringe, we shall not be able to draw up water through the tube; because the sides are sucked in, or, in scientific phraseology, are subjected to the pressure of the atmosphere. This is too obvious to have escaped observation.

When this is granted, and when it is also allowed that the veins of the neck are precisely in this condition; that is to say, in communication with a cavity that exhausts them by suction; so that, whether the power in operation be in the heart or in the thorax, the suction cannot, on any supposition, be effectual; some mode of accounting for the veins not suffering collapse must be sought for.

It is by such considerations that we perceive, that there is an element wanting in the argument. *What, then, are the circumstances by which the veins of the neck can assume the characters of rigid tubes?*

In looking to a person breathing high or anxious-

ly, when the neck and breast are exposed, we see, without the aid of anatomy, that the sides of the neck, collar-bones, and shoulders, are raised at each inspiration ; and that the effects on the veins of the neck are very remarkable. If the reader turns to the introductory part of this paper, in which the symptoms of hæmorrhage are enumerated, he will have a lively conception of what must be the effects of this rising of the shoulders during an operation attended with much loss of blood.

On examining the neck anatomically, we find the *platysma myoides* covering the side of the neck, and passing from the chest to the base of the jaw. This muscle lies over the external jugular vein, and the branches of veins which contribute to form it. The *sterno-cleido-mastoideus* takes its course obliquely upwards on the neck, to be inserted into the mastoid process. This muscle, with the anterior portion of the *trapezius*, and the clavicle, form a stratum lying over the internal jugular vein and the subclavian vein. This mass moves continually in breathing. The muscles, during inspiration, are lifted off the veins of the neck, and, by removing the atmospheric pressure from them, allow them to dilate. It is especially in high-breathing, that this influence of the muscles, in drawing blood into the veins, is powerful. On the subsiding of the action, during expira-

tion, the blood of the veins is propelled downwards in its course to the heart and the regurgitation is prevented.

But, perhaps, experiment may be necessary to illustrate the effects of the action here described.

Most of my experiments, I am happy to say, have been performed on the dead body. I made an incision on the neck of the subject near the clavicle; in the bottom of the wound I opened the vein, and filled the wound with milk; I then forcibly raised the shoulder, when the milk was absorbed into the vein. I requested Dr Reid to repeat this experiment, well aware of his ingenuity in such matters, and in his hands the success was perfect.*

* My dear Sir.—In accordance with your request I performed the following experiment.

In a subject, the thorax of which had been previously opened, an incision was made across the upper part of the lower third of the neck, through the integuments and *platysma myoides*, so as to expose the external jugular vein. An opening was then made into the vein, and by detaching the integuments in the neighbourhood of the vein, a small cavity was formed, capable of holding between one and two drachms of water.

This cavity was now filled with water, and the shoulder and clavicle were forcibly elevated, when the whole of the water entered this orifice of the vein.

To prove that the water did not enter from gravity, the cavity was again filled with water, and although a minute (and in subsequent experiments a longer time) was allowed to elapse, the

It must appear to the reader, that the state of the parts in death, and the raising the shoulder in this condition, is but an imperfect representation of what actually takes place in sobbing and sighing, or in the sudden alarm when one draws his breath convulsively. The experiment is, however, explicit as to the effect of raising this stratum of muscles and membranes off the veins which lie under them. Conceive, then, the condition of a person under operation, exhausted by the loss of blood, sighing and drawing breath as we see patients do in these circumstances. Conceive the veins opened, and the effect of a touch of the knife on a nerve—the sudden and repeated elevation of the shoulders and the chest ; and we can have no difficulty in comprehending how the air enters the circulation.

water did not change its level ; while, on the shoulder being raised, it rapidly disappeared through the orifice of the vein.

The same experiments were repeated, and with the same results.

It was distinctly noticed that, if the shoulder were very rapidly raised and again rapidly depressed several times, the water disappeared very slowly, and even sometimes appeared to remain nearly of the same quantity, though fluctuating ; part of it being drawn into the vein during the elevation of the shoulder, and again forced back during its depression ; while, on the other hand, if the shoulder when elevated remained in that position for a short time, the water entered and disappeared, and did not again reappear in the wound when the shoulder was allowed to fall back.

I have the honour to be, your obedient servant,

(Signed) JOHN REID.

This subject has other interesting relations,* but we shall pursue our inquiry, *How is it that air admitted into the circulation causes sudden death?*

The researches of the French commission leave the subject obscure, for their many experiments are contradictory. It is at one time conceived that the animal submitted to experiment, dies in consequence of air admitted to the heart : or, again, to air passing into the minute vessels of the lungs ; while others attribute the effect to the air being sent into the carotid artery and into the brain.

It has to be remembered that the mode of death which we have to explain is not such as we observe from a wound of the heart, for then death does not occur without symptoms, and more or less suffering. Nor is it death from congestion in the lungs that we have to explain ; nor from the bursting of a vessel in the brain, where there is a period of ster-tor, and life is prolonged, though some volition be lost ; but death on the instant, without a motion to give alarm, or to indicate the change which has taken place.† The heart, lungs, and brain, are undoubted-

* See the concluding note.

† I went into the dissecting-room of the Professor of Veterinary Surgery, Mr Dick : I found there a class of intelligent young men. They kill their horses and asses for dissection by blowing. Some said the animal would be convulsed, and struggle for a minute ;

ly vital parts, yet all of them, when affected with disease, cause protracted suffering. What part is it which being injured will deprive an animal of life, as by a flash of lightning? It is by this course of inquiry that we are directed to some more vital spot. Some centre, which shall instantly and simultaneously influence the organs of breathing, of voice, and of expression. There is but one spot, which, being injured, shall have this effect—the *medulla oblongata*, giving origin to the nerves called Respiratory.

I readily concede that a blow on the stomach will kill instantly; that a blow on the breast, inflicted on the malefactor, is the *coup de grace*. I have said also, that a blow on the throat has been quickly fatal. In these instances, the influence still falls on that vital respiratory system, by which voice and expression are instantly lost, and death must follow quickly. It is recorded that, in experiments, a bubble of air will be sent from one cavity of the heart to another, and, nevertheless, it has not had an immediate deadly influence on the organ. The stomach may be removed from an animal, and that animal will continue to live. These facts indicate that when a

others, that he falls over at once motionless. It cannot surprise us that air in the heart and circulation of the lungs should be attended with distress; but that is not what is sought to be explained,—it is the sudden privation of life.

blow on the stomach kills, it is by an influence reflected back on the great nerve of the stomach to the centre of all these vital motions; and so I can believe that a *blow* on the heart may have a similar consequence, though a bayonet through the heart has no such instantaneous effect. It is rapidly mortal, but not without symptoms.

Again, experimenters record these extraordinary facts, that, when the brain is removed, the animal continues to breathe; that when the *par vagum*, that is, the nerve of the lungs, is cut, respiration continues; that after the *par vagum*, the sympathetic nerve, and the spinal marrow, are divided, breathing continues; that when the animal is exviscerated, the breath is still drawn!

Now, in contrast with all this, there is a point which, rudely touched, deprives the animal at once of every indication of life in sound or motion. In whatever manner injury may reach this part, it must be the source of death, in the instances we have stated. It may be an injury of the extremity of a nerve, given to the stomach or the heart, which propagates the fatal influence to this centre. But there is another mode in which its vital power may be suddenly cut off, namely, by air sent to the vessels of this vital part. We know the intimate, the immediate dependence which all organs, and especially those of

sense and motion, have on the circulation of arterial blood. Now, air passing into the vessels of that portion of the spinal marrow which is the source of all these vital motions, must kill instantly, like the crushing of the part itself.

In conclusion, we find from the Veterinary Professor that it requires three expirations from his lungs to kill a horse. We learn from the pupils that sometimes the horse or the ass struggles before death, but that he oftener dies by falling over at once without motion. The Professor informs us, too, that when, in bleeding a horse, "he hears the noise of air entering the vein, he claps his thumb upon it." We learn that the same thing has happened in operating on the neck and on the axilla, and that the patient has been saved by the same means. But we are most struck by the awful suddenness of the death in other circumstances, giving a powerful interest to the inquiry. I have on several occasions, when my brethren have been operating on the neck, slipped my hand in to press on the veins between the wound and the clavicle. When amputation is performed at the shoulder, the arm should be so held as to prevent the sudden rising of the clavicle, and if this cannot be done, let the mouths of the divided veins be compressed, until the final dressing and bandaging.

ADDITIONAL NOTE, No. I.

The natural course, to illustrate our subject experimentally, would be to blow air into the vertebral arteries, and observe the effects. But there is great difficulty in this. I applied to the veterinary pupils, requesting them, that, when they killed their animals for dissection, they would attempt to convey the air into the vertebral arteries ; but in this attempt they failed.

In the mean time, I may refer the reader to a note in my paper on the Nerves of Respiration, &c. “ I may here add a conjecture on the provision for securing the circulation through a part so vital as the *medulla oblongata*. The vertebral arteries are supposed to run in the canal of the cervical vertebræ, in order to secure the circulation in the brain, in the event of compression of the carotids ; but, considering the command which this part of the medullary column exercises over the actions of respiration, and that it is more vital than the brain, may it not be a principal object of this very peculiar course of the vertebral arteries, to supply the organ of respiratory motion, free from the casualties which influence the supply of blood to parts of less consequence to life?” See Nervous System, 8vo, p. 110.

The interest of the subject is increased in no ordinary degree by the experiments of Sir Astley Cooper, who found life terminated without a struggle, in consequence of compressing the vertebral arteries.

 ADDITIONAL NOTE, No. II.

In another part of these essays, I have had occasion to point to the peculiar condition of the circulation within the skull. In the action of the muscles of the neck, to which I have now been ad-

verting, we see another peculiar provision for the free descent of the blood from the brain, as well as for diminishing the tendency to regurgitate. When the veins of the neck are injected in the dead body, we see that the internal jugular vein is remarkably enlarged where it lies under the mastoid muscle ; it forms here a great sinus. During respiration, especially high or excited respiration, this sinus is alternately subjected to the pressure and elevation of the incumbent parts ; the blood is drawn into it by the elevation of the clavicle and mastoid, during inspiration ; and pressed down in the course of the circulation towards the heart, by the subsidence of the incumbent parts during expiration. Without such an influence, there would have been an absolute stagnation of blood in the veins and in the brain, during fits of coughing, sneezing, and straining. But I have to shew that this action of elevation and depression of the muscles of the neck is undoubtedly the reason why the trunks of the absorbents enter into the venous system at this part.

It is correctly stated, that where two streams meet obliquely by the union of two tubes, there is a negative point at the part ; there is no pressure of the fluid outwardly. Now, it is in such a part that the thoracic duct pours in its contribution, unopposed. But there are many such angles besides the union formed by the subclavian vein and jugular. As to the thoracic duct mounting on the neck, that the fluid from it may descend with force, it is a weak argument ; for as long as the ascending part of the trunk is longer than the descending part, on the principle of the syphon, no additional force can be gained. I apprehend the reason on the contrary to be, the thoracic duct, by thus ascending under these active muscles of the neck, receives an impulse from them, both drawing and urging the chyle towards the veins.

If the subject were to be prosecuted, we might inquire what difference is to be observed in the course and termination of the trunk of the absorbents, when there is another form in the apparatus of respiration, than that which we find in man and quadrupeds. “ In birds and reptiles,” says Dr Alison, “ there is a communica-

tion between the lymphatics and other veins than those of the neck." And in the batrachian animals, Professor Müller observes, that the trunk of the absorbents of the lower extremities, enters into the veins of the pelvis ; and a trunk of the absorbents of the upper part of the body joins the veins of the neck. But, in both these parts, there is this remarkable circumstance ; that a pulsating ventricle or bag is attached to the termination of the absorbing vessels, to assist in the propulsion of the chyle.

It thus appears, that, in mammalia, there is a rising and suction, through the action of the muscles of the neck, of which advantage is taken to aid the flow of the chyle. In the frog, the air is received into the pharynx, and propelled into the vesicular lungs ; and this change of the vital apparatus requires a different adjustment of the thoracic duct.

ESSAY II.

OF BLEEDING IN APOPLECTIC ATTACKS, AND THE DIFFERENT EFFECTS OF DRAWING BLOOD FROM THE ARTERY AND FROM THE VEIN.

CIRCUMSTANCES have occurred which have led me to resume the examination of this subject.

The volume and impetus of the blood transmitted to an organ being in proportion to the importance and the activity of the function of the organ, we perceive why there should be more blood sent to the brain than to any other part of equal size. When we consider, further, the extreme softness and delicacy of texture which distinguishes the brain, we see that it must be guarded from injury in a manner peculiar to itself.

The dangers which we have here to consider are from internal impulse; and though analogy may not be the best mode of reasoning, yet there is so much resemblance in the condition of the eye to that of the brain, both being subject to the same impulses

and concussions, that in contemplating the one we may learn to appreciate the provisions in the other.

The dangers to the eye, as well as to the brain, result from the impulse conveyed in a retrograde direction along the column of blood in the veins, which impulse, were it permitted to reach the extreme vessels, would be destructive of the web of nerve in the eye, or the structure of the brain. During passion, when the face is flushed and the veins turgid; during bodily exertion, when the respiration is stopped and the return of blood from the neck and head impeded; during a fit of coughing or sneezing, when the blood is driven, or regurgitates, towards the head, what protects the eye? what protects the brain?

The interior of the eye is protected during these jars—by the resistance of the strong sclerotica to distention—by the action of the muscles of the eyelids, which grasp and sustain the eye in consequence of their consenting in action with the muscles of respiration;* and, in an especial manner, by the forms

* If, while you yawn or sneeze, you put your finger on your eyelids, you will find, that, by the action of the orbicularis, in combination with the muscles within the orbit, they become as firm as a board. We see why the eyeball suffers in paralysis of the eyelids; for then this support is lost. If we hold up the eyelid of a child to look into the eye, while it is screaming, the conjunctiva is in an instant distended with blood, and for the same reason—the want of pressure and support to the surface.

of the veins themselves. Mr Alexander Shaw has given* a very ingenious explanation of the *vasa vorticosa* in the choroid coat, which by their form subdue the impulse along the veins of the head, that would otherwise reach the interior of the eye. The artery of the optic nerve and retina, it is likewise to be observed, is as tortuous as the internal carotid or the vertebral artery.

Thus, in the firmness of the sclerotic coat of the eye, the ready consent of the muscles to sustain the globe, the form of the *vasa vorticosa*, and the twisting of the arteries entering the eye, we see a provision against the impulse on the columns of blood, and the concussions to which its delicate parts are subject.

Now, looking to the condition of the brain as somewhat similarly situated—as subjected to injuries from without and impulses from within—we perceive how it is guarded against the latter. First, we perceive in the tortuous form of the arteries entering the brain, that it is preserved from the agitations of that system. Next we perceive that the veins are lodged in strong sinuses, formed by the dura mater, and strengthened by the chordæ Willisii, and which sinuses receive the impulses conveyed retrograde from the veins of the neck; the veins, likewise, which

* Medical Gazette, Oct. 1837,

join these sinuses, take a sweeping and curved course, by which the shock is diffused, before being carried onward to the minute branches ; so that, becoming a general impulse on the mass of the brain, that organ is sustained by the uniform support and resistance of the skull. Take away a portion of the skull, and free the brain from this uniform support, and we have demonstration of its influence, by the protrusion of the brain and the bursting up of its vessels, during a fit of coughing, or during the violent efforts of intoxication or delirium. If in fracture of the skull the longitudinal sinus be also opened, the blood is poured out in a torrent during a fit of coughing.

Considering now the peculiar condition of the brain, and that there is no free space within the skull, certain consequences result : the fulness of the cranium, and therefore the equable support it affords to the whole mass, the tortuous form of the arteries entering the brain, the strong walls of the sinuses protecting the veins, cut off this important organ from all the irregularities to which the circulation of the trunk and limbs are subject, in the varying postures of the body, and in the impulses caused by the straining of the thorax and action of the limbs.

The head and neck may be surcharged and bloated with blood ; while the brain will preserve its na-

tural condition as to the quantity of blood in its vessels.

If the arteries encounter a resistance to their dilatation by the contact and pressure of the brain, they must move that mass in dilating. Then the blood in the veins must partake of the motion thus communicated to the brain, and blood will be driven from the veins in proportion to what enters by the arteries. I thought of determining this fact by experiment, when circumstances occurred to render it unnecessary ; for, in a case of fracture of the skull, where a splinter had opened the longitudinal sinus, the blood came from the wound in pulsations, synchronous with the pulse at the wrist.

It would therefore appear, that, from the fulness of the brain-case, and contact of all contained, the action of the arteries of the brain gives an impulse to the veins ; and the veins cannot yield to that impulse in any other way, than by the discharge of blood in the direction of the circulation.

It must follow, that an impediment to the exit of blood from the sinuses, must prevent the free dilatation of the arteries. On the other hand, whatever facilitates the descent and flow of blood from the sinuses, must give freedom to the action of the arteries of the brain.

But further, when the skull is fractured and the

dura mater torn, we have another series of phenomena conducing to the right understanding of the condition of the brain and its vessels. On violent exertion, coughing and sneezing, the brain is forced out from the hole in the skull. The brain rises both by the impulse of the arteries and the shock carried retrograde by the veins. When, however, the patient dies, a remarkable change is apparent. The protruded brain has subsided within the skull and dura mater ; and the surface of the brain has sunk away from contact with the dura mater.

From this it is manifest, that, in proportion to the mass of the brain protruded during life, there must be an accumulation of blood either in its veins or arteries, or an effusion of serum upon the surface, or in the cavities of the brain. Again, it must have been by the escape of blood from its vessels and the receding of this blood to the heart in the act of dying, that the brain fell off from the dura mater, and air was admitted into the brain-case between the brain and dura mater.*

By these considerations, or with these *præmissa*,

* Some of my friends speak of hypertrophy of the brain. Hypertrophy of the heart may be attended with excessive action. But increase of the mass of the brain, did it ever take place, must be attended with diminished circulation. Whence then should it arise ?

we are prepared to comprehend the effects of extravasation of blood, upon the brain.

The studious reader will perhaps think that I have been too long of referring to Dr Monro [secundus], on this subject ; who taught us the incompressibility of the brain : or to the very excellent commentary by Dr Kelly. The latter made ingenious use of the elements taught by our common preceptor. My late esteemed friend, Professor Coleman, found no plethora in the vessels of the brain, of animals which had been hung. Dr Saunders and Dr Seed [thesis 1815] found that the veins of the brain were not depleted by bleeding ; and Dr Kelly made many ingenious experiments to the same effect, shewing that, if the vessels of the brain were in any degree emptied, serum must in the same measure be effused. All these experiments are to shew “ the difficulty of repleting or of depleting the vascular system of the brain.”

The principle, however, wanting in these inquiries, is the very essential one—that all qualities of *life* are maintained through the active circulation of arterial blood in the substance of the organ. The stagnation is equally fatal with the entire want of blood. Yet, not denying the beneficial effects of bleeding in apoplexies, authors linger on the hypothesis of Cullen, that drawing blood takes off the pressure of the vessels of the brain upon its substance, and so affects “ the mobility of the nervous power.”

Pressure on the brain ought not to enter into the inquiry. If the brain be inflamed, we bleed to diminish the velocity of the circulation—the freedom with which the blood passes from one set of vessels into the other—because it is this active transmission of blood from artery into vein by which the inflammation is maintained. If we suppose that a vessel is ruptured in the brain, we bleed to diminish the force of the circulation; because we know that the mouth of a torn vessel will close by the coagulation of the blood when the stream is diminished in force: it is the same principle which makes us bleed in a deep wound with hæmorrhage in the lungs or in the abdomen.

But, as the circulation within the skull is peculiar, a question arises, in what vessel, in vein or artery, ought we to bleed? a question, as I take it, of vital importance.

Let it be supposed that an artery of the base of the brain, by disease of the coats, or by violent impulse, gives way. The blood thrown out, is diffused around the brain, until checked by the general resistance. In proportion as the blood escapes from the torn vessel, the vessels generally must be compressed,—there must be a resistance to their dilatation; and, consequently, their action must be diminished, for there is neither free space nor compressible substance within the skull. Whatever energy

of function depends on the freedom of circulation in the brain, must be diminished, or altogether lost.

When the smaller arteries of the brain, in consequence of previous softening of the brain, or independently of that cause, are ruptured and give out their blood, as often happens in the *corpus striatum*, the general effect is less, the partial injury greater ; the clot presses aside, or ruptures the fibres or the tracts of the brain on which sense and motion depend. But the extravasation may exceed its first bounds, the blood may burst out and deluge the surfaces, or fill the ventricles, producing apoplexy, supervening on partial paralysis.

How is this outbreak, which is comparatively trivial at the first, to be limited ? What means have we of diminishing the arterial impulse, without taking off the general pressure which tends to resist the further extension of the clot ? Bleeding, it has been said, cannot diminish the quantity of blood in the brain. This is true ; but it can retard its velocity, and alter the relative proportion of it in the veins and in the arteries. It can prevent that blood from forming a mass of coagulum, instead of being retained in its natural state within the vessels.

Let us endeavour to make a familiar illustration. Suppose we take a glass-jar from the trough of the chemist, fill it with water, close it, and through the

cork or luting introduce two glass-tubes also full of water. In this state invert it. If the tubes be of equal length, no water will flow ; but if one be longer than the other, the water will pour from it, whilst air ascends by the other tube. But if, instead of admitting air, the shorter tube has its mouth in water, that water will be drawn up, and, if coloured, it will be seen to be received and diffused among the water in the jar. The reader cannot mistake which tube represents the vein and which the artery ; nor will he fail to perceive that, if facility be given to the descent through the long tube, the coloured fluid will diffuse itself more freely by the shorter tube.

After the preceding statement, is it proper, in the case of extravasation of blood in the brain, to open the temporal artery, or to draw blood from the venous system ? It is evident to demonstration, from the external arteries of the head and the internal arteries of the brain being branches of the same trunk, that the opening of the external branch must, on all principles, vital or hydraulic, diminish the flow of blood through the internal. If, while looking on a jet d'eau, we see the column of water suddenly drop, we may be assured that some one is drawing water from a branch of the same conduit pipe.

If blood be drawn from the veins, and more especially from the veins of the neck, facility is given to

the descent of blood from the sinuses, and the pressure on the brain is diminished, by which the tendency to the extension of the clot and to the additional flow of blood from the burst artery is increased.

It has been to me a matter of observation, and has indeed led me into this disquisition, that a patient being sensible of a seizure, and feeling his arm and leg numb, has had the temporal artery opened ; and as long as the blood drawn jetted with force, he has continued to be relieved. Afterwards, being copiously bled from the arm, I have found him completely paralyzed on one side. Now, this increase of the evil may have been the uncontrollable progress of the disease ; but, as the same thing has occurred more than once, it gives rise to serious considerations.

Apoplexy is an extensive subject ; and our respect to ancient authorities places it in great obscurity.*

* Apoplexy is characterized by the semblance of profound sleep, with stertorous respiration. Sense and volition are gone, while the respiration and the action of the heart remain. Syncope is distinguished by the influence commencing in the heart. In apoplexy the heart beats after the last drawn breath.

Some authors contend for stertor being invariably an accompaniment ; others find apoplexy without stertor. *Stertor* is produced by the breath playing through the relaxed velum, and may be avoided by attending to the position. By turning the body a very little, the velum falls forward, and the breath is drawn softly. The

But I limit myself to the case of clot from ruptured vessels in the brain. In such a case, apoplexy and palsy are allied,—a rupture of a vessel in the brain may partially break up the texture of a portion. Is it not the tearing up of the brain, as distinguished from the general extravasation, that occasions the contraction of the pupils in some cases? and is it not this tearing of the fibres which produces partial debility in the frame, or a numbness and inability to move in the opposite limb? But the blood, as in external hæmorrhage, may burst out again, become diffused on the surfaces, cause general pressure, and so apoplexy will succeed to palsy. Or it may happen that the first burst shall be sufficient to deprive the patient of all sense, and yet the clot may so contract and waste that, from the apoplectic state, the patient survives; and there remains more or less impediment to the motion or sensation of the part of the frame to which the injured fibres of the brain refer.

Certainly cases do not always occur in this simple form. Let us present to ourselves a case where we

agony of a family around a dying person may be much mitigated by so simple an expedient; yet great authorities measure the strength of the disease by the degree of stertor; or, again, they say that *snoring* is pathognomic of apoplexy. It is correct of laborious breathing: the more the respiration is affected, the more imminent the danger.

see the cause, progress, and termination. A fellow has drunk himself into a state of apoplectic stupor ; from similar states he has often recovered ; but now he dies, and a clot is found in his brain. Here we have the dangerous state of arterial excitement artificially produced. But there is a similar condition of the brain and its vessels, where, instead of intoxication, a spontaneous and morbid excitement prevails, attended with a dangerous activity of circulation. There is redness of the eyes, turgidity of the features, vertigo and drowsiness, and ringing of the ears, and torpor of the hands, and every symptom of “fulness of blood” in the vessels of the head. Bleeding and antimonials may subdue this paroxysm ; but after a time it returns without apparent cause, and the blood is driven impetuously to the head. This is not a disease of the vascular system, but of the brain ; a condition of the organ which draws after it the excitement of the vessels. And of all the feats of skill which the physician has to perform, the correction of this disposition is the most difficult and the most meritorious. The mere reduction of the force of circulation by the use of the lancet leaves the cause prevailing, and the danger recurs.*

* A communication has been made to me, which touches this subject. “Your old patient Leslie, from whom you took a large

There are other circumstances to be briefly noticed, lest I be thought to teach that drawing of blood is the sole or chief order of practice, in what are termed "head cases." When I have examined the head of a man who has died of apoplexy, and found a clot of blood extending from the *corpus striatum* into the ventricles, it has appeared to the bystanders quite satisfactory, the cause of death being apparent. But when we try back, and compare symptoms, we find that the friends interested in the patient have not only observed him declining in

portion of the skull, has had fever, followed by erysipelas of the head; it was frightful to see the quick hammering of the dura mater, more forcible than the pulse at the wrist."

This reminds us that the brain may, in these circumstances, be in danger from general vascular excitement, as well as by that excited through the brain. It may further give us reason to wonder that the brain can sustain such evident disturbance, unless we suppose that something similar always prevails.

In stating briefly, as in the text, that condition of over-action in the vessels of the head, which is the consequence of brain affections, I ought, perhaps, to remind the reader that similar symptoms arise from a less dangerous influence; that we see it in disturbance of stomach, in uterine derangement, and in fever, &c. There is an advice descending to us from our elder physicians, *e. g. Hoffman*, vol. i. p. 344, *Centur.* ii. and iii., *Sectio* iii., *Cos.* xiv., and others, to regard the effects of suppressed hæmorrhoidal bleeding. I see reason to regard that caution; and to advise bleeding from the hæmorrhoidal vessels, rather than from near the head, when periodically requisite; the physiological reasoning is obvious.

health, but a degree of dragging in the leg, long previous to the final attack which has suddenly proved fatal. There must, then, have existed some cause of numbness and weakness previously, and independent of the violent tearing up of the brain, and general pressure from extravasated blood. It is in such cases that, instead of finding a large artery ruptured, there is a series of lesser vessels, the mouths of which cannot be discovered, which have given out their blood ; so that we are directed to a state of the brain antecedent to the rupture,—a partial diseased state attended with softening, and into which the blood has been poured.*

There is yet another cause of apoplectic symptoms which it is well to notice, especially with a view to the use of the lancet. The veins of the neck being pressed upon, as by violently turning the head, by inverted position, or partial strangulation, apoplexy is induced. Here it is not an accumulation of blood in the brain, but an interruption and stagnation, which, equally with the rupture of a vessel, influences the brain and diminishes the nervous energies. On the

* I must admit that there is extensive softening of the substance of the brain, without extravasation of blood. However we may look upon it, it is the premonitory symptoms that are most obscure in this interesting inquiry : the *precursors*, the headach, ringing in the ears, vertigo, hesitation of speech, and torpor of the hands, are not explained by a clot of blood in the brain.

examination of the brain in such cases, the veins of the brain are turgid to an unnatural degree, accompanied with a corresponding compression of the arterial system. Here the effect is not much different from the strangulation of any other part. The blood is accumulated in the veins, and the circulation arrested, and the activity of the arteries diminished proportionally. Thus, death is not the effect of pressure on the brain by the distended veins, but the oppression of the free arterial action. I must again refer to the fact, that it is not the quantity of blood within the vessels of the brain which sustains the functions, but the free passing of the arterial blood from the smaller arteries into the veins; we see therefore how sense and motion are diminished, and at length life extinguished, without rupture of a vessel.

If this condition of the circulation could be with precision ascertained, bleeding from the vein would be preferable to opening the temporal artery.

One more example in explanation of the state of the circulation in these cases. An elderly person, stooping, as in tying his shoe-string, having risen, falls and becomes apoplectic. In the first place, the compression of the chest and the difficult descent of the blood through the veins of the neck retard, or, to a certain degree, impede, the free entrance of blood by the arteries of the brain. But on suddenly rising to

the erect posture, there is a more dangerous period ; for then the blood has more than freedom of descent from the head ; the lengthened column drawing down the blood from the state of remora, it rushes into the brain through the artery, attended with pain and giddiness ; and then it is, if I have not deceived myself, that owing to the pressure, which is the security of the vessels of the brain, being suddenly taken off, the artery gives way.

We have, hence, in such an occurrence, two distinct causes of *defaillance*,—the interruption to the free exit of the venous blood, and consequent impediment to the dilatation and action of the arteries, which of itself will cause apoplexy. Again, we have the rapid descent of the blood from the sinuses into the veins of the body, and the pressure taken off from the brain, giving rise to rupture of an artery. But the rapid re-entrance of blood into the brain produces very unpleasant effects, without rupture.

Take, in illustration, the pressure on a nerve. When we sit too long pressing on the ischiatic nerve, the circulation is impeded in it ; when we rise, the circulation returns forcibly ; and if the limb be then used, it is weak, numb, and painful ; as we say, “it is asleep.” Here the sudden return or readmission of the blood into the nerve has more dis-

tressing effects than the partial deprivation of blood which the nerve had sustained. The same effects result from the temporary application of the tourniquet to the limb.* Is the analogy a fair one,—that, after being long in the stooping posture and suddenly rising, and the blood having unusually free admission to the brain, giddiness and inability to command the limbs are the consequences?

If we look to the paper by Dr Fothergill† on the practice of Bleeding in Apoplexies, we perceive a struggle in his mind between the prevailing precepts of the profession and the experience of the acute and learned physician. It is a subject, he says, “which requires the most dispassionate consideration.” He gives a case which made an impression on me, when I heard it from the mouth of Dr Gregory, in his lectures. It is known to every one, because the same circumstances are recurring from time to time, to renew the recollection. It is that of a gentleman passing the Thames in a wherry, and looking round at his brother’s vessel, “he kept his eye on her after she had gone by, till he lost himself and sank down in the boat.” Here we have obstruction to the exit

* The return of sensibility, after suspended animation from drowning, is attended with painful irritation.

† In an appendix to his paper on the Cure of Epilepsy,—his Collected Works, vol. iii.

of blood from the head, and consequently obstruction to the entrance of it. If our premises have been just, there can be no turgescence,—no more blood in the brain than is necessary to it. But there is a remora, an interruption to the free course of the circulation, and a loss of that support of the vital operation which is bestowed through the circulation.

In conclusion, if the lancet is used, under the impression that there is extravasation of blood, and the fear that the clot may become more extensive, the most efficacious mode is to open the artery.* If remora and obstruction to the exit of blood from the head be suspected, then phlebotomy is proper ; still, in that case, arteriotomy is not improper.

* Draw the shoulders of your lancet across the anterior temporal artery so that you partially divide it ; and judge of the quantity of blood to be drawn, by the force of pulsation and the distance to which the stream is sent.

ESSAY III.

ON SQUINTING—ITS CAUSES—THE ACTUAL CONDITION OF
THE EYE—AND THE ATTEMPTS TO REMEDY THE DE-
FECTS.

IT is pleasant to turn from the contemplation of the effects of violence, and the more severe operations of surgery, to a delicate operation which remedies a defect (which at least gives great uneasiness), and is really a triumph of art. But, while it is agreeable to witness the rapidity with which information is received and acted upon, and the eagerness of surgeons to put in practice a new operation, it is to be regretted that the physiological principles relating to the cure of this deformity have not been more attentively studied.

Vision is a subject of high interest in a physiological point of view. It has been studied by our philosophers in every age, and now a correct knowledge of the functions of the eye becomes more especially of practical importance, by enabling us to judge of the propriety of operations for the cure of squinting.

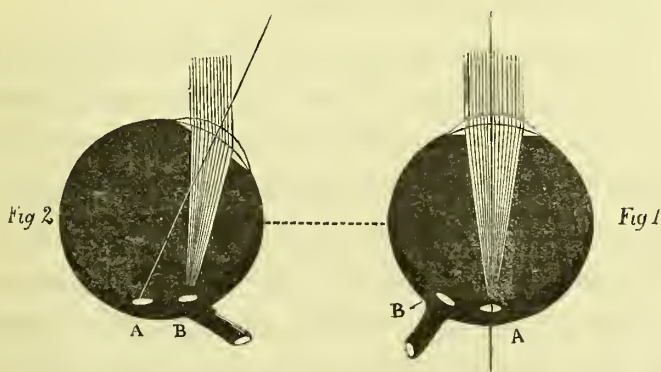
I have to confess that when, formerly, I endeavoured to shew the strict relation which exists between the action of the muscles of the eye and the impressions on the retina, I met with criticism from one, whose authority carries great weight in these inquiries. But my respect for that gentleman does not overcome the conviction that, on this question, and on all that regards the exercise of the eye, we must hold in view two distinct properties of the organ,—the reception of light on the retina, and the consentaneous action of the muscles of the ball of the eye. This relation becomes a matter of the first consequence in endeavouring to comprehend the subject of squinting, and to enable us to judge of the propriety of the operation for remedying the defect.

There are in the retina two spots distinct in their properties from the general surface. Though not antipodes in place, these spots are opposed to each other in respect to sensibility, one being exquisitely sensible to the impression of light, and the other absolutely insensible. The sensible point is in the axis of the eye, and is the foramen of Sœmmering; the insensible spot corresponds to the insertion of the optic nerve.* When the rays from an object im-

* See Mariotti, and the Experiments of De la Fond, *Cours experimental*, t. III. § MDCCCXCVII. Haller, *Picturæ locus*, lib. xvi. t. v.

pinge on the sensible part, animation and effort are immediately given to the guiding muscles of the eye. When the rays fall on a part of the retina removed from this centre of sensibility, and more so when they strike on the absolutely insensible spot, the stimulus to a correct action of the muscles is lost. We shall presently find that the defect of the weak eye of one who squints, is mainly in the tonicity of one muscle, and that it is at this time of comparative inaction that the other muscles prevail against it.

Take the plan, fig. 1, as representing the right eye, and the small circle A as the sensible spot; the rays from the object falling upon A are seen, and



animate the organ. Suppose fig. 2 to represent the left eye distorted to the degree that the rays fall on B, that being the insensible spot, the object is not perceived with that eye.

The farther from the sensible spot in the axis of

the eye the rays from the object fall, the less distinct is the image. Thus, in the common experiment by which an object is seen double, that is, of looking on another object beyond it, so that the rays are made to fall on the inside of the central and sensible spot of the retina, these double impressions are weak, compared with the single image. Accordingly, it is not required that the rays should fall on B alone, to be neglected. If the point on which they do fall be considerably removed from the spot A, the muscles of the eye will be without their sufficient stimulus to correct vision; and, being left uncontrolled, the weak muscle will yield to the prevailing tonicity of the others.

We ought not to leave this subject without noticing the advantage derived from the central spot of the retina being more sensible than the general field. Were the whole surface of the retina equally susceptible of the impressions of light, we should be dazzled, and see nothing; the direct light, whether of the sun or of a lamp, would overcome, by its intensity, the reflected light from the object to which the eyes were directed. That rapid search which the eye makes in surveying a scene,—the desire to have the object which is faintly seen on the general field of the retina presented to the sensible centre, as well as the happy consequences of that perfect vision which

results from the sensation on the retina, being combined with the voluntary direction of the eye, would all be lost.

Leaving this department, let us give more attention to the muscles of the eye. And I shall be excused in stating here what I have already taught on this subject.* The eyeball is suspended in a cellular and adipose membrane so loosely, that it is like a thing floating in water, ready to move on the slightest impulse. It is surrounded with muscles; the four recti embracing it, and terminating forwards; the two obliqui embracing it, and terminating backwards; while it is covered anteriorly by the orbicularis of the eyelids. We contemplate these muscles in two conditions,—a passive and tonic state, during which the eyeball is poised between them; and the more animated and active state, when the axes of both eyes are directed to an object. When the muscles are left in their passive state, their unexcited condition, the eyelid is dropped, and the pupil a little turned up; this is the state in sleep.

But of these muscles a certain class is voluntary. At the moment of awakening, the *atollens palpebræ* lifts the eyelid, and the recti muscles direct the axis of the eyeball to an object, or search for it; and that

* Nervous System.

search is to place the centre of the retina in such a relation to the object as that the reflected rays from it shall fall on the sensible spot, and then the object becomes distinctly visible. Vision thus obtained is the conjoint operation of the voluntary muscles of the eye and of the impression on the retina; and this double operation is necessary to perfect vision. It is that state of speculation which implies scrutiny; the motion, and sense of the eye being combined; and the correspondence in motion and in sensation of both eyes being perfect.

When a child has never seen, as in the case of congenital cataract, when there may be sensibility to light, without an image *seen*, “the eyes roll in different directions, and without correspondence.”*

But certain of the muscles of the eye have another all-important office, without the performance of which we should not long enjoy sight,—the protection of the organ. For this the exquisite and peculiar sensibility of the surfaces of the eye, and of the roots of the cilia, is bestowed; and under this sensibility the action of the muscles is arranged. For example, in couching, the surgeon entreats the patient to command himself, and to look straight forwards, which he does; but the instant that the eyeball is touched

* See the cases, No. CVI. of Nervous System.

with the point, it is *involuntarily* turned inwards and upwards. What is the object of this in nature, and how accomplished? Is not this the position of the eye of one who has a decided squint? May not the investigation of the one condition tend to the understanding of the other?

How directly the cornea is turned towards the inner canthus, may be determined by a simple and harmless experiment. If, on closing the eye, and placing the point of the finger on the eyelid so as to feel the convexity of the cornea through the eyelid, we make an effort more firmly, and, as it were, spasmodically, to shut the eyelids, as if something were entering the eye,—it will be found that the cornea slips from under the finger, towards the inner canthus. On ceasing to exert the eyelids, the cornea returns again under the point of the finger to the centre.

The apparatus for throwing out what is offensive to the eye is not so perfect in man as in quadrupeds; but the mechanism is in some degree the same. The caruncle with its glands, and the *membrana semilunaris*, are less perfect than the hawk, and the muscles of the human eye are deficient in the retractor muscle; but the action of those which we possess is the same, when there is irritation of the surfaces. The eye is dragged towards the *os planum*, the cor-

nea is turned to the caruncle, and the fold of the conjunctiva, called semilunaris, is thereby thrust forwards. By this means the dust which is floated towards the inner angle of the eyelids, is extruded.

It is obvious that this motion implies the combined action of all the muscles of the eye and eyelids, with the exception of one, most material to our subject,—that is, the external rectus. Without the relaxation of this muscle, the cornea could not be turned into the inner canthus; and without the alternate motion of the cornea to and fro, by the successive contraction and relaxation of the external rectus, the eye could not by any action free itself of the offending body. We come to the conclusion, then, that the external rectus has something to distinguish it from the other muscles; and so far we are on our way to comprehend its peculiar defects. We perceive that, in an obstinate squint, the eyeball is exactly in the position into which it is thrown in the sudden action of guarding the eye!

We may observe here, that the operation of cutting across the rectus internus muscle for the cure of a squint, was not undertaken on a deep consideration of the condition of the rectus externus; but it was to cut across what appears to the patient's feelings to tie the eyeball, and confine it towards the nose. Sometimes the patient, when you examine the eye,

and desire him to turn the eye outwards, says he cannot do so beyond a certain degree ; and he will add, that it seems tied. But this is not a common attendant on squint.

Neither is there a doubt but that the internal rectus, by its continued action, acquires strength ; while its antagonist, the external rectus, by the reversed condition of relaxation, becomes weak. The opposite effects which have followed the operation of cutting the muscles, and the disappointments, after much experience, call for a more philosophical investigation of the subject.

Every person understands, that to act, requires a stimulus to the contracting muscles. But it is only a physiologist who can comprehend that in every such action, there must also be relaxation of the opposite set of muscles. And I have elsewhere* said, that this is not a relaxation like the throwing loose of a rope. The relaxation of a muscle is as fine, or rather a more delicate administration of power than the contraction. It is the derangement of this relaxing influence which produces squinting.

Many of the actions or motions which, in a morbid condition, or resulting from accident, appear irregular, and cannot be accounted for, may be ex-

* The HAND, a Bridgewater Treatise.

plained by a careful study of the natural functions. Thus, in No. CIII. of the cases in the Appendix to my volume on the Nervous System, we find this passage,—“ There lies in the hospital a patient with a fracture of the base of the skull, in whom there is a regular motion of the eyeball, as regular as the motion of a pendulum, from right to left.” In case CV., the same motion is noticed,—“ It is not so much upwards and downwards, as in a transverse direction.” This is a derangement in the condition of the *rectus externus*, imitative of its natural function.

I must now advert to some of my experiments* on these muscles: a more objectionable mode of inquiry, perhaps, from its cruelty; yet I thought I was making it unnecessary for others to have recourse to the same. Experiments must be made on the monkey; the only animal that has the same muscles as man. The possession of the powerful *retractor oculi* will render all experiments on quadrupeds unsatisfactory.

I divided the *rectus superior*; the animal lost the power of raising the eye, when he raised the eyelids, and turned up the other eye. The eyelid was held open, and the eye touched with a feather; the cornea was instantly turned up, and in a greater degree than in voluntary action.

* See Nervous System.

This was surely sufficient proof to shew that the recti and obliqui were distinct in office,—that there were two distinct muscles employed in raising the eye; the one, the rectus superior, directing the eye in vision, and voluntary; and the other, the inferior oblique, acting involuntarily, for the protection of the eye, and for wiping the cornea, and dipping it in the fountain of the tears. Those who could not assent to the argument, that the oblique muscles perform their motions more rapidly than the straight, and, therefore, that these different classes could not correspond in any combined actions; or who could not see that, if there was a necessity for oblique muscles to direct the eyeball, there should have been four muscles and not two, might still have given their belief to so decided a proof of difference between them as this experiment afforded.

I cut the superior oblique muscle of the monkey. He was very little disturbed by the experiment, and turned his eyes in all directions, with his characteristic inquiring looks. On holding open the eyelid, and waving the hand before him, as threatening the eye, the eye turned up further than the other eye; and there was a hesitation and apparent difficulty in bringing it down again.

The division of the inferior oblique muscle did

not in any sensible degree impede the voluntary motions of the eye.

If any one will give a moment's consideration to the subject, he will see that the eyeball must be rolled upwards by different muscles. When we look upwards, the eyelid, as well as the cornea, is elevated; and there must be a perfect accordance in the action of the superior rectus and of the *attolens palpebræ*, or the pupil will be hid under the eyelid. But as the cornea is raised in the other action, for preserving the eye, while the eyelid is depressed, it must be effected by another muscle, namely, the inferior oblique, which consents in action with the *orbicularis oculi*. The one muscle accords with the elevation of the eyelid, the other with its depression.*

It would appear that our operators sometimes think physiology a matter foreign to their pursuits. Yet, in this subject, we cannot comprehend the most common occurrence without a knowledge of function. There is a squint, for example, that puzzles not a

* If the intelligent reader will peruse the cases of involuntary motions of the eyes, consistently with perfect and steady vision, he will have additional reason to conclude that vision is a double operation, combined, of the impression on the retina, with the sensible operation of the muscles of volition. See *Nervous System*, p. 374. ¶ *Nystagmus bulbi*.

little, and obscures the reasoning in common cases of true *strabismus*. The cornea is directed upwards, attended with adhesion to the eyelid. This is one of the effects of the action of the inferior oblique, in turning up the eye during irritation. In inflammation, the irritation being excessive, the cornea is turned up, and often it is permanently fixed by adhesion in that position. In such distortion of the eye, the interior has probably suffered; often the eyeball is small and sunk.*

Out of these experiments, there arises a question;—When one of the recti muscles is divided, the pupil is directly and permanently drawn in the contrary

* We ought to have a term for this permanent distortion, and *Lusitas* is by some applied. But authors use it in different senses. “*Strabismus* est, quando uterque oculos ad exteriora conversus est, *Lusities* quando introrsum ad nares.”—*Boerhaave*. The conclusion of the paragraph I like better, “Omnes hi morbi nunquam intelliguntur nisi cognitis conditionibus, quæ ad visum requiruntur.” The unequal action of the muscles moving the eye is *Strabismus*. The unstable and frequent motion of the eye, *Hippos*, by Galen. See *Histoire de Chirurgie*, De Gorter, &c.

The eye may be tied by adhesion, so as to be drawn from the true parallel, and so produce double vision. The adhesion may be stretched, or the eyelid may be so relaxed, as to admit the ball to resume its place. See *Langius* as quoted by Porterfield, Ed. *Med. Essays*, vol. iii. p. 159. Such adhesions, when the interior of the eye is sound, admit of operation.

direction : why does not the same follow the division of the internal rectus, in those that squint? We know nothing until this be explained.

DOUBLE VISION—THE STATE OF THE EYE IN INTOXICATION.

In soporific affections, the brain influences the muscles unequally. In intoxication, we have demonstration of what we may also perceive in the end of fever, and in acute hydrocephalus. By our best physiologists, the position stands thus,—When the brain is oppressed, the muscles which are most directly under the will are the soonest affected, and to the greatest degree. The progress of the drunkard, from the first stage, when he attempts, in vain, to snuff the candle, to his finally falling under the table, gives proof of the gradual manner in which debility encroaches on the muscular system. First of all, his sight is affected, and he sees double ;* because the recti muscles, those of direct volition, soonest yield to the influence, and the obliqui, the involuntary

* It is classical. Pentheus driven to fury by the Bacchanals, is made to see double ; two suns. Virgil *Æneidos*, iv. 469 ; Eurip. *Bacchæ*, 918 ; and Juvenal, sat. 6.—*jam vertigine tectum*

Ambulat, et geminis exurgit mensa lucernis.—

muscles, prevail, so as to disturb the adjustment of the eyes.

Double vision, then, is the deranged condition of the muscles of the eyes, by which the rays from an object are made to fall on points of the retina which do not correspond; and two weaker images, instead of one stronger, are presented to the mind.* Still this distortion of the eye is not a squint, nor does it depend on the same cause.

I have known a person who squinted, to be sensible of two images, one distinct, and the other very feeble. But, in general, he who squints sees single. The difference is manifest between double vision

* In hemicrania and sympathetic pains of the head, the eyes suffer. *Dexter oculus visu tantum non omni privatus si cum sinistro simul ad videndum aperitur omnia objecta sistit duplicata: hinc aliquid lecturus, scripturus aut exacte consideraturus, dextro clauso solo sinistro uti valet oculo, &c.* *Hoffman, Cent i. Sectio i. Cas. iii.* Double vision coming on in the adult, we fear that gutta serena may follow. *Disput. Inaugural. Halleri, De Visu duplicato. Obs. iv.; Ratione eventus in visum duplicatum curabilem, Obs. 1, 2, 5, 6; incurabilem, Obs. 4, 11; lethalem, Obs. 7; see also Briggs.* With double vision we have Vertigo. It disappears when the patient shuts one eye and sees single, if it proceeds from derangement of the action of the muscle. A person with double vision from slight cerebral affection cannot see, he is afraid of losing his way. But on closing one eye, he sees perfectly. Here, when both eyes are used, the impressions are not made on the centre of either eye, and hence weakness and confusion of sight. See cases by Dr Mackenzie of Glasgow, p. 302.

and squinting. In the former, both eyes are distorted, and on both the image is faint, because the rays from the object do not fall on the central points,—the sensible spots of the retinae. In the latter, that is, in squinting, the defect is in one eye. It is distorted, and the rays fall on the less sensible part of the retina; whilst the sound or unaffected eye has the rays falling on the sensible spot, and the sensation is distinct. By and by, the stronger image is alone contemplated, to the exclusion of the weaker, and single vision is the consequence.*

A SQUINT—HOW PRODUCED—THE CONDITION OF THE EYE.

A person who squints has one eye distorted; notwithstanding which, he sees single, and is not sensible of any defect. If the stronger eye be shut, he readily turns the weaker to the object. Nor must it be forgotten that, when looking with both eyes, the weak eye accompanies the strong in every motion, but always preserving the same relation,—the axis of the weak eye deviating in a certain constant

* I beg the reader to peruse the case CXII. of the Nervous System, and to reason upon it.

degree from that of the stronger one. These facts do away with the idea that there is any one of the recti muscles incapable of action; or that the cause of squinting is any thing more than a certain degree of imperfection of the muscular power.

The following is a frequent occurrence, and it shews how liable the external rectus is to derangement, and the effect of weakness in it. An elderly lady complains that she sees double. It appears that this is only when she directs her eyes to the left side. I place myself before her, and she sees me correctly and distinctly. I move to the right side, and she still sees me single. But when her head is kept steady, and I move to her left side, and direct her to follow me with her eyes, she sees me double,—she sees two figures, one-half of the one figure over the other. I move a little farther to the left, and the images separate. Still as I move farther to the left the images are more separate, and one is faint compared with the other.*

We see here in an elderly person the progress of that defect in the rectus externus, which leads to squinting. When the external rectus of the left eye is relaxed, the imperfection is not perceptible.

* See a case precisely similar, in my *Nervous System*, No. CXVIII. See also the case in the succeeding pages 389 and 390.

The muscle is defective only inasmuch as it cannot fully contract, and therefore the eye cannot be directed outward to the degree that the other eye is directed inwards. The consequence is, that the impressions on the two retinæ no longer correspond,* and the more the right eye is turned toward the left, the farther are the impressions on the retinæ apart, and the farther the images seem to separate.

With this state of the ball of the eye, the upper eyelid is sometimes relaxed and fallen. Nor should it surprise any one, who has observed that there is a natural connection between the shutting of the eyelids and the inversion of the cornea, that both conditions should take place from the same influence,—the relaxation of the rectus externus and of the attollens palpebræ. The relaxed eyelid and the inverted cornea are frequent concomitants, however we may account for it. In every step of the inquiry we shall find occasion to revert to the natural conditions and actions of the eye.

I have just examined a lady who sees naturally well, when the objects are near; but at ten feet off, they are double. The reason is, that the eyes have a due power of converging; but to be directly paral-

* See Halleri disp. Anat. v. iv. De visione qua oculo fit gemino.

lel, requires more action in the abducentes; and they being weak, the parallelism is not perfect.*

I have watched the commencement of a squint in a child, and have observed it from occasional distortion, to the confirmed strabismus. At first, mamma said, "Sir, you are squinting:"—master was stuffing with apple-pie. The occurrence gave it the more interest to me; and the parents being my friends, I watched the boy. When challenged, he could, by attention, look straight; but after a time he lost the power, and a most determined squint was the consequence, which now disfigures the man.

I prefer, when I can obtain it, the opinion of an unbiassed observer. A friend writes—"To-day I had the opportunity of observing an incipient strabismus in a boy of eight years of age, while waiting with his mother in the hall of the hospital. I noticed the squint, which was in his left eye, to be most manifest while he was sitting listlessly, apparently in a day-dream. On calling to him, and having his attention awakened, there was an obvious difference; the squint almost disappeared."

In confirmed strabismus, joined to the distortion there is a defect in the retina itself. When the sound

* The same kind of defect was observed by Sir Everard Home, quoted by Mr Mackenzie on the Diseases of the Eyes. *Diplopia*, and Phil. Trans. for 1797, part i. p. 7.

eye is shut and the squinting eye turned towards you, the sight is seldom strong; very often when you hold up the watch, the patient cannot tell the hour,—perhaps not see the bars of the window. Here a question of practical importance arises—Is squinting purely a defect in the action of the rectus externus: and is the weakness in the retina consequent on the distortion, from want of use? or does the retina participate in the original defect? Is the imperfection of vision concomitant or consequent?

When I examine a true case of strabismus, with the view of determining on the propriety of dividing the internal rectus, I find the pupil turned towards the nose, and after a time it is turned inwards and upwards. This proceeds from the relaxation of the superior oblique, and consequent prevalence of the inferior oblique.

This, however, is no reason against the division of the internal rectus. But let it not be supposed a reason for dividing either of the obliqui. These are muscles provided for the preservation of the eye, and ought not to be deranged.

Every thing tends to shew that, in *strabismus*, the proper and common squint, the defect is in the relaxation of the rectus externus, and that the action of this muscle is impaired, not lost. It is the tendency of this muscle to relax, and not the increased

power of the rectus internus, which is the cause of distortion. Were the action of the first altogether lost, then would the cornea be turned towards the caruncle ; and there it would remain, as when the muscle is accidentally divided in a wound.*

In experiments on the monkey, the division of one of the recti muscles gives the ball entirely up to the action of the opponent. That the division of the internal rectus of the human eye, in those who squint, does not cause a distressing squint outwards, is owing to the weakness of the external rectus, and is an additional proof that the defect is there. An intelligent correspondent informs me, that a surgeon having cut the internal rectus of both eyes, the patient looked “like a vicious mare going to kick.” This change from the “bull-eye,” few would deem a happy effect of the operation.† But such must be the effect of cutting the internal rectus, if the ex-

* The complete division of the rectus externus causes the eyes to turn inwards. See *Sennertus*, as quoted by Boerhaave, *Prælectiones*, T. vi. DCCCXLVI. The man had received a wound in the orbit, which cut the rectus externus. This turned the pupil towards the inner canthus. He afterwards had a wound which perforated his nose ; “et totâ vitâ suâ per vulnus et nasum, tanquam opticum tubum, objecta vidit !”

† The bull, when he levels his horns to the ground, has his eyes directed inwards and upwards. In death, especially in bleeding to death, the eyes are so distorted. “Ita Plato ait, Socratem cum brevi ante mortem de anima disseret, *taurinum* inspexisse.”

ternal possesses all its power. There are circumstances in the anatomy of the orbit which explain the property in the eyeball of turning towards the nose when the rectus internus muscle has been divided. The orbit is oblique : the foramen opticum is nearer the mesial or central line than the eyeball, and the muscles diverge obliquely outwards to their insertion. By this position the superior and inferior recti have a power over the eyeball when the internal rectus has been divided. If we consider the habitual position of the eyeball in those who squint, it will appear that this action of the superior and inferior recti will be increased.* Such, I apprehend, is the reason that the pupil is not immediately turned out on the division of the internal rectus. It has not escaped the reader's attention, that the united action of the whole muscles of the eye is to turn the pupil inwards, and to squeeze the eyeball to the inner canthus when the organ is irritated.

If the definition of a squint be correct, that the patient sees with one eye only, while the other is distorted and neglected, then he cannot squint with both eyes, though he may squint alternately with one or the other. A patient will look at an object with one eye only, and it is indifferent with which. If the

* See note XVI.

object be on the right side, he will look at it with the left eye ; if on the left, he will look on it with the right. Here there is no defect of the retina, and the abducens muscle of both eyes is weak, and hence the prevalence of the internal rectus in both, so that the left eye is easily directed to the right, and the right to the left side.

In a case of this kind, Dr Darwin supposed the defect to arise from a depraved habit. I think it more probable that the influence, which deranges the action of the rectus externus of one eye, should affect both ; my surprise being that, if the cause be in visceral disorder, and operating through the large connection of the sympathetic nerve with the abducens nerve, both eyes should not be oftener affected. [See note at the end.]

A respected friend and old pupil writes thus:—
 “ The gentleman did not present any appearance whatever of squinting, till about the time when the ladies withdrew, namely, when we may presume the process of digestion was established.

“ Both eyes were equally affected, and the squint consisted in each eye occasionally turning too much inwards.

“ After much watching, and observing the effect of his directing his orbs (which were unusually prominent) to the objects on the table, I satisfied myself

that he could direct either eye, with the natural degree of power, in any particular direction. But it seemed that, on each occasion of turning his eyes, he regarded the impression on one eye exclusively; that is, one eye appeared fixed in a true line on the object under his view, while the other eye squinted inwardly.

“For example, if he looked on a dish or decanter to his right side, the right eye had the object truly covered, but the left was penetrating to the cavities of his nose, or was turned to the glabellum, and *vice versa*.

“The explanation seemed to be this:—When looking to the objects on his right side, he employed the right eye, as being the one most favourably placed for viewing objects on that side, with a greater amount of volition, or a more positive effort of the will, than the left eye. He preferred, as it were, exercising this eye and attending to its impression, to using the eye situated unfavourably.”

My friend proceeds to argue the matter ingeniously. I may state it thus:—The defect is in the rectus externus of both eyes. In looking aside, say to the right, the recti externi are in opposite conditions; the rectus externus of the right eye is active, the strong stimulus of the will is upon it in a state of contraction; the rectus externus of the left eye is

in a state of negative activity or relaxation. It is in this state that it exhibits imperfection, betrays weakness, and relaxes too much ; consequently the other muscles prevail, and the eye is distorted inwards. Matters are precisely reversed when this gentleman looks to the left side.

These cases, differing from the common one of pure strabismus, shew that to judge of the precise condition of the eye requires both knowledge and natural acumen, which, as I am proud to say of a pupil, this last communication evinces.

I have the less difficulty in believing that, in some rare instances, the violent crying and convulsive struggling of a child shall produce squinting, because in that state of excitement, what we may call the natural condition of the eye, is exactly that of strabismus ; the cornea in passion being dragged inwards and upwards. But, in common cases, every thing tends to persuade us that the defect consists in a certain weakness of the rectus externus. We see a squint produced under a crapulent state of stomach ; and at an early period, it is cured by attention to diet and the state of the abdominal contents. As I have just said, the relation between the great class of visceral nerves, the sympathetic, is most direct with the sixth nerve, in its course to this single muscle ; so that the deduction from the

anatomy corresponds with our experience of symptoms.*

The more that any one knows of the fine adjust-

* Squinting is attributed to many causes. It is said to be hereditary; and so it may be considered. But the cause is rather to be looked for in the disposition to a certain disorder of the abdominal functions, than to a direct influence on the eye. It is attributed to the position of the infant in respect to light, or to some attractive object; to the habit of looking to its nose; to improper education, &c. All this is misplaced ingenuity. It is equally an error to suppose, that when the eye is defective in sensation, it is left to wander. The distortion is not a *wandering*, but a necessary consequence of a certain defect of the outer rectus muscle, in nineteen out of twenty cases.

In treating of squinting, we must not forget that the muscles of the eye are subject to a variety of derangements; and although the external rectus is most frequently deranged, the other muscles are not exempted.

“Palpebrarum quoque et bulbi oculi, musculi non raro afficiuntur, ubi imi ventris nervi irritantur. Quanta mutatio in oculis infantum observatur quorum prima regio saburra acri repleta est? inordinate et rapide hinc inde moventur, nunc sursum nunc deorsum, abconditis sub palpebris pupillis modo ad latera attrahuntur modo extra orbitam pelluntur, vel intra ipsam deprimuntur; in aliis palpebræ distrahuntur, bulbi figuntur, ut attente objecta aspicere crederes, somno licet correptos hæc omnia horrorem adstantibus injicientia spectacula evanescent, simulac alvus subducitur, vel vomitu acria expelluntur.”—Rahn de miro inter Caput et Viscera Abdominis Commercio, § xiv.

A case is related by Pamard, Journ. de Medecine, t. 23, p. 63, of a spasmodic squint cured by a critical evacuation of the bowels; and Borelli, Hist. et Obs. rar. Med. Cent. ii. Obs. 1, has a case of strabismus occurring in a woman on every recurrence of pregnancy.

ment necessary to correct vision with both eyes, or the more he thinks of the combination of muscles accessory to vision, the greater must be his surprise that an operation so rude as that of dividing one of the muscles, should have the effect of curing squinting. Reasoning *a priori*, one would say, that the effect must be to produce double vision, by bringing the images on the retina nearly, and not absolutely, to a correspondence; and the surprise is rather increased than allayed by the fact, that in some instances it has the effect referred to. Why, then, is it not the same in all? Because the person continues to see with one eye only.

In the last twelve patients whom I have carefully examined, operated on by different hands, one only has vision of the eye which was cut. In that case, the sisters inform me, that she did not always squint, but only occasionally; and, “as mother thought,” only when her stomach was deranged.”

It is one thing to cure the distortion, another to cure the squint and restore the perfect use of the eye. In the other cases, the individuals do not use the eye operated on. The sensibility of the retina is weak, and the image is obviously not regarded. Perhaps this is a happiness, since in certain instances, double vision has been produced; and to see correctly, the person has had to put his hand on one eye.

The effect of cutting the internal rectus is not to destroy its action finally and altogether ; but after a time the divided muscle must form adhesions more or less directly to the eyeball.* In a case seen whilst I am writing, the internal rectus was divided, and I was disappointed in finding no effect at the first. It is now the fourth day, and the distortion is quite removed. We must conclude that the division and reunion diminishes the power of the muscle, and reduces it to that state of action in which it is equivalent to the external rectus, and no more. Its reunion to the side of the eyeball, through the intervention of the cellular membrane, must be attended with considerable curtailment ; and the happiest result is when that curtailment and consequent diminution of power correspond with the state of debility in the external rectus.

The subject is highly interesting ; the result truly surprising and beautiful. Here is an operation which removes a great striking deformity. We have yet to wait for results : ingenuity has been baffled ;

* It is said we have no proof of the reunion of the muscle ; but we see it in other instances ; at all events, it is pertinent to observe, that some of my friends divide the tendinous insertion, others go back to the belly of the muscle and divide it.—See the last of the additional notes on the action of the rectus superior and inferior.

we must be patient for experience. Let not the operator promise perfect success as to the restoration of vision in the eye. What I have said will, I hope, stay the hands of those who, without reflecting on the distinct action of the muscles, and devoid of the necessary experience, divide other muscles than the internal rectus. Before dividing the internal rectus, let the operator deliberate well on the condition of its opposite, the external rectus. If the affected eye be incapable of turning outwards when the other is shut, let it be ascertained whether this proceeds from weakness in the rectus externus, or from an adhesion on the inner side. Let the operator well consider whether the deformity has arisen from disorder of the muscles merely, or from disorder attended with inflammation and with adhesion.

I am a little sceptical on the subject of adhesion causing a squint, and its division being attended with perfect success. In a common squint there is nothing to produce inflammation and adhesion. The defect is in the muscles. That the internal rectus should be increased in power is not improbable. Nor is it impossible that it should degenerate. But, as in squinting, the weak eye moves freely when the strong eye is covered, it is evident that the distortion does not proceed from that cause.

ADDITIONAL NOTES.

The manner in which I have studied the subject lately, has been to note the cases as they occurred, keeping to the facts simply. The reader may apply to them, the reasoning in the text as an exercise.

I. This young woman desires to know if she should have the “new operation” performed upon her eye.—The left eye squints—not always—it is irregular in its movements—the vision in the left eye is imperfect. She cannot tell the hour with it on my watch—nor see the bars of the window :—when she puts her hand on the right eye, she can distinguish me with the left—on raising the hand from the right eye, the left turns slightly towards the nose.

My opinion is, that the operation will not improve her sight—the squint is not complete—it is more an unsteadiness from want of acute sensation. The effect on her countenance is hardly a blemish.

II. I am requested to decide for or against the operation in this young lady’s case. The left eye squints,—it is turned towards the nose, and a little upwards—a confirmed squint. On closing the right eye, she sees with the left, and can direct it fully in the circle. It was after the measles that she was observed to squint.

The feebleness of the impression on the retina is no objection to the operation. I think she should submit.

I saw this lady eight days after the *R. internus m.* was divided—the effect was good—the eye was unsteady ; but nothing to deform an agreeable countenance. The fungus, which sometimes rises in the place of incision, is in this case very large ; having been touched with caustic, it is at present ugly. It will disappear.

III. Mrs ——— she squints inwards, not upwards, with her right eye. Sometimes she sees double ; when I retire from her to the distance of nine feet she sees two objects ; when I hold the watch near, she does not see double,—in reading, she does not see double. She says, long before this proposal of cutting for squinting, she wished that something was cut which tied her eye. The eye is large ; it is in consequence of the white part being turned forwards. When I make her cover the sound eye, and look at me, the eye appears to be diminished. She says, the double image is like the double rainbow, one distinct, and the other like its shadow.—*Operate.*

[Eight days had passed.] The eye cut is now direct in the centre—she moves it outwardly to the full extent. It is with pain that she directs it to the nose. On the day succeeding to the operation she felt as if at sea, with an inclination to retch,—the room moved up and down—felt as if the room was unsteady.

There is no such affection as authors describe, where particular objects are seen double and not others : “Ubi quædam tantum modo objecta geminantur, reliquis simplicibus apparentibus.” They may see near things single, and far off things double ; because they direct the eyes more easily with the axis converging, than when they are parallel.

IV. This woman is satisfied with the success of the operation. She says, she sees with the eye operated on. She deceives herself as they all do. She squints distressingly. I advised that after a considerable interval, the operation should be repeated with certain precautions.

V. ———. His *Rectus internus* was cut in the left eye a fortnight ago. This man's eyes are in a very curious condition. His appearance is greatly improved, but there is a glimmer, which makes it difficult to say which eye is unsteady. He looks at me sometimes with one eye, sometimes with the other. The

eyes do not perfectly correspond. He says he sees best with the eye that has been operated on. This is not true; he cannot tell the hour on my watch with that eye, though readily with the other.

[Second inspection.] He is not improving,—and I suspect he does not see in ordinary with the left eye. He has no double vision. On making him look to the left side, he cannot turn his left eye round to the natural extent. Is this debility of the *Rectus externus*, or adhesion of the *R. internus*?

VI. A fine young man. Operation performed ten days ago. There is now no unpleasant distortion of the eyes—nothing to disfigure, or to be unpleasant in the countenance.

But on carefully observing his eyes, there is a want of perfect consent. The eye operated on is more prominent than the other. The pupil is a little larger. He says he saw double at first. He sees an object as well when the left eye is closed, as when both eyes are open. He was cut on the left eye. The motion of the eye is free in all directions.

VII. A respectable young woman; the eye was operated on by ———. It is perfect in all respects. Her sister tells me that she only squinted sometimes; and that mother says, it was only when her stomach was disordered.

VIII. To-day Mr ——— brought me two patients on whom he had operated. The results very satisfactory. As he had operated on many, I asked him if he had ever felt the necessity of dividing anything like a ligamentous binding of the eye. He answered, Never; but he thinks that, in some instances, the muscle has been stronger than natural. He divides the muscle, not its tendon.

IX. A fine young woman; the eye operated on, traverses freely—turns freely outwards—squinted at an early period. It was a very bad squint. She does not see double—cannot tell the

hour on my watch. She appears not to attend to the impression on the weak eye.

X. Mr ——. I recommended this young gentleman to submit to the operation. Mr ——, who operated on him, came to me this morning in some distress, on account of no change having taken place in consequence of the division of the internal rectus. He expressed a wish that I should go and see the eye, and determine if he should do any thing more. I said, not now, if the eye is still directed towards the nose ; the operation may be repeated hereafter ; but nothing can be done now.

Second day from the operation ; he tells me the eye has become quite right, and is now directed straight forwards.

Visited Mr ——, and found the improvement as great as in the most favourable cases. *Quer.* Did spasm fix the eye, as I remember to have been the case in my experiments on dogs after having divided one of the recti ?

[Jan. 3.] This gentleman and his family are well satisfied with the operation. What I observe is this,—he does not commonly use the left eye. The vision in it is not perfect,—he can use it, and then the sound eye inclines a little inwards. The axis of the eyes are parallel in looking straight before him. But this is not from a just sympathy of action. He can turn the left eye in all directions ; but not so far outwards as the right eye is turned inwards. He has no double vision—no pain in looking to the right or the left. His left eyelid hangs a little.

XI. In observing this patient, cut three weeks ago, I find some things not a little puzzling. He says he saw double before the operation : He now sees single ! The distortion is cured,—the improvement complete. But as I make him look to the right and left, following my watch, which I hold up, the eye operated on will make an irregular movement, upwards or downwards, or rapidly, first the one, and then the other. He says, the eye operated on is the strongest now.

This irregular movement of the eye is an action of the obliqui—it is like the action of the eye in *Nystagmus Bulbi*. See appendix of the Nervous System, p. 374–5. See De Gorter, p. 250, “ Ut et motus instabilis et frequens Bulbi, qui Hippos vocatur.”

XII. [By letter.] This lady squinted ; she could by an effort bring the eyes so nearly to parallelism as to satisfy her friends, that she could, if she chose, cure her squint. But when she thus satisfied them, by an effort, she saw double. She submitted to the operation of dividing the *M. Rectus internus*. The eye is restored to a correct position, but she sees double. By an act of volition she can see single ; but then it is observed, that the eyes are distorted ;—What will be the final result ?

XIII. Double vision succeeding the operation for strabismus.

A little boy (C. P.), came to get medicine for his sister. Observing that he squinted, I put some questions to him. Although a decided squint remains, it appears that he twice submitted to operations for its cure. He mentions, that both his eyes originally squinted ; and that in the left eye was much the worst ; nevertheless, he saw clearly. A surgeon, about five weeks ago, operated on this eye ; and the operation has been attended with remarkable success, so far as rectifying the position of the eye is to be taken into account ; for it has now lost all appearance of squint. It was afterwards attempted, by a different surgeon, to make the cure complete, by operating on the right eye ; but the result has proved unsuccessful, for a very obvious inversion of the eye in the direction of the glabellum remains.

The patient, although a little fellow, shews clearly enough that he by no means congratulates himself on having fallen into the hands of the surgeons. He blames them for making his eyesight weaker. He now sees everything double and confused ; and to verify his statement, looks at various objects, and says that there appear to be two of each. He is too young to allow of our

depending on his answers to more difficult questions ; but on the above point he speaks emphatically."

XIV. A friendly critic has observed that I have omitted to shew the peculiar condition of the rectus externus muscle, as exposed to visceral irritation. I have hinted at this, and I thought with sufficient distinctness, elsewhere ; and at different times I have explained more precisely the relation of the great visceral nerve, the sympathetic, to the sixth nerve ; and why this sixth nerve is wholly given to the abducens, or external rectus muscle of the eye. I believe it is through this communication that the abducar muscle of the eye is so peculiarly subject to defect of action from disordered function of the abdominal viscera. See further in the succeeding Essay.

XV. Once more to measure the dimensions and form of the orbit, the position of the foramen opticum with regard to the globe of the eye, and the obliquity in the direction of the recti muscles, I went up to the rooms and dissected the parts within the orbit. But this investigation need not have been made ; for I recollected a plan in Mr John Bell's plates of the Bones and Muscles, which demonstrates beautifully (p. 54) the position of the eyeball, the obliquity of the muscles, and the necessary difference in the length and direction of the straight muscles.*

This position of the eyeball, and oblique direction of all the muscles, is not accidental ; at all events, it is attended with this effect, that when the muscles are excited by irritation of the eye, the ball is drawn towards the os planum. I have noticed that, in this general excitement, the external rectus or abducens is relaxed. But I have here especially to remark, that, by the direction of the superior and inferior recti, they tend to turn the eyeball inwards, and must, when the internal rectus is divided, prevent the eye from being distorted outwardly.

* He quotes Camper, Winslow, Petit ; Academie des Sciences.

If the eyeball should be turned inwards, as in those who squint, the course of these muscles, from their origins to their insertions, becomes more favourable to that action of directing the eye inwards; and this is the reason, I apprehend, that when the internal rectus is cut, the pupil sometimes continues to be turned inwards.

XVI. 20th, This gentleman's eyes appear quite natural. The eye has been twice operated on. The first time the Rectus internus muscle was divided. The second time the internal edges of the superior and inferior rectus were divided. He is a sensible person, and says, as to the vision of the eye operated on there is no improvement. He sees the face of the watch with that eye, but not the hands.

ESSAY IV.

ON THE ACTION OF PURGATIVE MEDICINES ON THE DIFFERENT PORTIONS OF THE INTESTINAL CANAL, WITH A VIEW TO REMOVE NERVOUS AFFECTIONS AND TIC DOULOUREUX.

ONE advantage of mature years is the means afforded of tracing chronic cases through all their phases. I have seen a patient to-day, with a pain so acute and fixed that I should have concluded it was indicative of deep inflammation, but that I was in consultation on the same patient, for the same pain, sixteen years ago. It is important to our subject, that in all this time there has been no morbid change discernible.

The reader may peruse several cases of painful nervous affections which I published many years ago ; and, among others, a case of severe *tic douloureux*.* This patient died last year ; when no disease of the nerve affected, or of the brain, could be discovered by the most minute inspection. As the case

* The case of Charles Delafield. Clinical Lecture,—Appendix to the volume on the Nervous System, Case LXXVIII.

was a severe instance of the true *tic*, and as the dissection gives unusual interest to it, I shall transcribe the introduction.

“He presented himself, a miserable object; his head surrounded with a nightcap and rolls of flannel, which almost hid his face, pale and wasted with incessant pain. Seeing him so proper an object of the charity, I gave him a letter and wished him to come into the house. He expressed himself grateful, but he dared not; for he could not bear the restraint even of lying in bed, and had no relief from pain but in continual work in his business of a carpenter. His complaint was *tic douloureux*, and of that most severe kind which fixes in the centre of the cheek. It came like a flash of lightning upon him. I exhausted my little store of remedies, and still he returned, not weekly, but daily, a miserable object; a study for the painter if he desired to paint ‘the last man’—a man despairing.”

Last summer when in London, and on visiting the Hospital, I found the same man. Four years he had remained well, and had just returned to seek relief where he had formerly found it. Suffering under the disease, and perhaps of the effect of remedies, he has since died. Mr Shaw made the dissection, one whom, on such a subject, I would trust before all others. The fifth nerve was carefully traced;

the origins of the nerve and the brain examined ; but nothing preternatural or morbid was to be discovered. The abdominal viscera were inspected, and there was ulceration of the ilium.

This case may now be contrasted with those in the volume quoted, in which there were morbid changes in the fifth nerve, giving rise to a very distinct train of symptoms.

The opinions which some of the most influential members of the profession have advanced on the subject of neuralgic pains, tempt me once more to recapitulate shortly the distinctions in affections of the nerves of the face.

1. Crowding of the teeth, diseased alveoli and gums, disease in the antrum, will produce pain in the face resembling *tic*,—the rationale being, that disturbance and irritation on an internal nerve will produce pain, referable to the more superficial branches of the same nerve.

2. Disease of the bone through which the fifth nerve passes, or a tumour which involves the nerve in any part of its course, will give pain attributable to the extremity of the nerve, or to the part supplied with its extreme branches.

3. Disease in the nerve itself will produce excruciating pain, referable to the part supplied with its extreme branches.

4. In the true tic douloureux, there is no disease of the nerve, nor of the surrounding parts.

With respect to the first class, I have lately had an illustrative instance. Some of our dentists, in supplying defects, fix the false teeth in such a manner that they cannot be regularly removed and the gums brushed. The gums, no longer exposed to pressure as in their natural condition, become spongy and inflamed, and rise over the teeth. I was called to consultation on a lady in this condition. She made no complaint of her mouth, but of lancing pain in the cheek and temple ; and hearing much of tic, she had no doubt of her martyrdom to that disease. The symptoms not resembling those of the true disease, I prevailed on her with some difficulty to shew me her mouth. It was in a miserable condition. On making her remove the case which covered the gums, and unfortunately protected them from the brush as well as the natural pressure in mastication, they had become diseased ; they were spongy, fungous, and offensive. The remedy was obvious ; and the pains left her as soon as the gums and teeth were restored to a natural state, by the very simple means of a tincture of myrrh and camphor, and the use of the brush with chalk. Before this she had forsaken company and retired in despair.

I cannot resist contrasting with this an instance

of the true tic in the face. I was in consultation with my nephew, Mr G. Hamilton Bell, on the case of a lady, who presented a very singular character of countenance. Although not old, the whole range of teeth of both her jaws had been drawn; and, consequently, she looked prematurely aged.

The singular circumstance in this case was, that although suffering from tic douloureux, when one or two teeth were pulled she had relief; so in course of time they have all been pulled. And now, although teeth, and alveoli, and gums, are all gone, the disease continues. The truth is, that any violent impression will assuage the pain, and fortify the nerve against the remote irritation on which the true neuralgic pain depends. This I believe to be the reason why surgeons continued for so long a time to divide the infra-orbitary nerve, because it gave temporary relief. It may also account for the effect of galvanism in this disease.

With respect to the second class of cases, where the nerve is irritated by passing through diseased bone, the reader may consult a paper on *tic douloureux*, by Sir Henry Halford, in the Transactions of the College of Physicians. In that paper, the author describes the disease as produced by the affected branches of the nerve, passing through the foramina of the skull, and being there surrounded by dead or

carious bone. But, with all respect, I am bound to say, that however severe the pains may be in the extremity of the nerve in such cases, they differ from those characteristic of the true tic; and for a very obvious reason, the cause is continual, and the remission of pain imperfect.

As to the third class of pains in the face,—from disease in the nerve, or a tumour involving it; the distinguishing character is not only the imperfect and occasional, and slight remissions of pain; but such a case will always be distinguishable from tic, by the numbness or total insensibility of the parts to which the nerve is sent. For example, there is insensibility of the cheek and side of the tongue, whilst it is to these parts that the patient is assigning all his torment. The distinction will be confirmed, if the tumour is seated at the roots of the nerve, by the wasting of the muscles supplied by the fifth nerve.

The painful affection of the face, described by Fothergill,* and since called *tic douloureux*, does not affect the function of the nerve; in the interval of pain, the parts supplied by the nerve possess their

* In Observations on Hemlock, second vol. of his collected works. In a second paper on a painful affection of the face, there is that confusion of detail into which the most acute and learned physician will fall, unless he takes the assistance of anatomy.

natural sensibility. The nerve is not morbidly affected. It is influenced by remote irritation; the pain is infinitely more severe, while it lasts, than that produced by the morbid condition of the nerve itself, or of the surrounding parts involving it; and the relief in the intervals of the paroxysm is perfect.

It is this latter circumstance which forces us to look for the cause of pain in the remote organs; whilst the long continuance of the disease without giving rise to morbid structure, imposes the belief that it is owing to disordered function only; and this is confirmed by cures being made through very simple means. That the effects of remedies are not constant should only excite us to further inquiry.

It is difficult to arrange the true Neuralgic pains, —I mean those in which there is no visible disease in the affected nerve.

As to the pain in a remote part, consequent on the disease of the trunk of the nerve, the instances are very many; and the occurrence has become familiar, after the case published by Sir Everard Home; and that which I gave, very early, of a tumour in the popliteal nerve producing pains insufferable in the sole of the foot.* I have since had the

* Museum of the Coll. of Surg. 919. xxii. f. Operative Surgery.

case of Baron D——,* where injury to the popliteal nerve was attended with pains and spasm in the leg and foot; and an additional instance of the effect of a ball lodging on the radial nerve.†

The effect is easily understood in such cases. But why the irritation of one organ of the body should produce pain in a remote part, with which we see no direct nervous connection, is a subject of greater difficulty. Sympathy is an unmeaning word: it explains nothing; it is a mere substitute for sense. Mr Hunter used the term *continuous*, *contiguous*, and *remote* sympathy. Still, I hold the term to be most unsatisfactory. Mr Abernethy (p. 4)‡ leaning towards him, and, on the hypothesis of Dr Darwin, conceived that these impressions were conveyed to the sensorium, and thence to parts remote from the original seat of disease; Sir Benjamin Brodie inclines to Mr Abernethy; and thus we hold to each other, like men walking in the dark. It cannot be satisfactory to say, that the irritation is conveyed to the fibres of the brain; for why does the pain not return, by corresponding and parallel fibriles, to the same part from whence the irritation came?

* Ibid. 247. xx. E. Surgical Report.

† See a case of the splinter of a ball lying on the median nerve Med. Chir. Trans.; and a similar case referred to by Sir Benjamin Brodie.

‡ On the Constitutional Origin of Local Disease.

In some cases, we can trace the relation which causes remote pains, anatomically ; in others, we lose the course of nervous relation, and they appear irregular. A calculus in the kidney or in the ureter affects the testicle and the forepart of the thigh. " The irritating cause, namely, the calculus, operates in the first instance on the nerves of the kidney, through which its influence is transmitted to the venal plexus ; and from thence it is, as it were, reflected to the nerves of the testicle."

Such is the fact ; but is the rationale correct ? There is no reflection towards the testicle. Sensation is invariably propagated in a direction towards the sensorium ; not outwardly from the sensorium towards the part. The impression is propagated from the kidney towards the sensorium, and is attributed to the testicle and forepart of the thigh through a false perception.—Does the explanation stand thus ? When two fibrils are bound together, the one being disturbed, it communicates an influence to the other, and hence a sensation is attributed to the extremity of that nerve ? Or is it, that the painful impression being communicated to the sensorium by a nerve of an internal part (itself not sensible), the sensation is attributed to the external and more sensible cutaneous nerve which accompanies it ?

Sometimes the effect of irritation on a sensitive cutaneous nerve, is to cause convulsions in the part supplied by the corresponding muscular nerve. Thus I have found irritation on the fifth nerve, instead of causing pain, giving rise to spasm in the muscles of the jaws. In Sir Benjamin Brodie's valuable contribution to diseases of the nerves, we find convulsion of the lower extremity occasioned by the cutaneous nerves of the groin being stretched over an inflamed gland. Convulsive actions are more frequent from injury to cutaneous nerves ; neuralgic pains arise from internal irritation.

We shall find it difficult to explain how certain general conditions, which we call constitutional disturbance, shall fall with concentrated force on a particular part. Certain structures may be liable to the effects of constitutional disease ; but why should certain parts of the same structure,—particular nerves,—be the seat of irritation or of inflammation ? Why should the fifth nerve of the head, or the ischiatic nerve of the hip, be so distinguished ?

There is another difficulty in some of the cases of nervous pains ; perhaps in the most severe, and the most obscure, the nerve is not inflamed ; whilst in others it is sensibly affected, morbidly sensible on pressure, and inflamed. Shall we hereafter, with better experience, be enabled to make a distinction,

and say, that when, in these neuralgic pains, the nerve has no morbid appearance, it arises from remote irritation? but that, when it is really inflamed, it comes of constitutional causes concentrated upon it? Sciatica, and some forms of disease which I have met with, especially in the fibular and ulnar nerves, differ essentially from the pure neuralgic pain, or *tic*. The nerve is tender,—it is inflamed; in *tic*, pressure gives relief.* In these cases of inflamed nerve, the pain is severe (as I remember Mr Cline saying) even to death; yet it is different from those sudden flashes and sudden shocks which characterize true *tic*.

Putting aside the irregular symptoms which attend diseases of the heart and lungs, I shall devote these pages to the remote effects of derangement of the intestinal canal.

The derangement of the first process of digestion in the stomach, produces many affections of mind and body.† But taking the single instance of flatulent

* I offered some interesting cases of this kind in the Treatise on Diseases of the Urethra.

† Ex ventriculo corrupto, sordibusque impleto, crudelissimæ oriuntur cephalalgæ, otalgæ, et odontalgæ, in quibus nil nisi primarum viarum evacuatio proficit.—*Heincken de Morbis Nervorum ex Abdomine*. Dr Woolaston had a peculiarly inquisitive and philosophical mind, so that an observation of his is valuable. He ate some ice cream after dinner:—when sometime had elapsed, he

distension with spasmodic closing of the orifices, it will produce pain as if the sternum were rent, pain in the axilla and mammæ, and down the side of the arm.

2. Disorder and distention of the duodenum will produce pain, referable to the lower angle of the scapula.*

3. Accumulation in the colon, and consequent disorder, gives pain in the loins, spermatic cord, and groin.

4. Disease of the rectum produces pain in the testicle, the lower part of the scrotum, and inside of the thigh.

5. And disease of the anus, ulceration, piles, and fistula, will be sensibly felt in the schiatic nerve.

found himself lame, from a violent pain in his ankle;—suddenly he became sick, the contents of his stomach were rejected, and there was instant relief.

* Let me recommend the perusal of *Hoffmann de Morbis Duodeni*; not forgetting the paper of Dr Monro *primus*, on this intestine. (Medical Essays of Edinburgh, vol. iv.) I hope when authors speak of disorders of digestion, they mean to include the duodenum. Consider how it is pent in above the mesocolon—how it is tied down by the peritoneum,—how it receives the bile and pancreatic fluids,—and, if they be deranged, how its sensibilities must suffer,—and that, if the digestion in the stomach be imperfect, how this first portion of the intestinal canal must suffer. The old anatomists called it *Ventriculus Succenturiatus*, as performing the second process of digestion, a process subject to many causes of disturbance.

6. Disorder of the covering of the testicle will produce pain in the loins and cord ; and disorder of the body of the gland has intimate relation with the stomach.

7. Disorder of the uterine functions, as irregular menstruation, conception, pregnancy, and labour, whilst they exhibit the sympathy of the uterus with the mammæ, affect the spine and muscles of the back. Many a young woman suffers from the ignorance of this relation between uterine irritation and pain in the back. Weariness and languor, and a singular degree of morbid sensibility, attend the disorder, and the sensations are erroneously attributed to disorders of their spine.

These pains, comparatively external, may be reduced to a law, viz. that irritation on the internal branch of a nerve, by disorder of function in the viscera, will be felt or attributed to the external branch of the same nerve. It is the same law by which inflammation of the liver will be recognised in the pain of the shoulder.

But I proceed further, believing that irritation in certain parts of the canal, produces neuralgic pains in more remote parts;* and that one character of these

* In this all authorities agree : Vogel, Hoffman, Whytt, Sydenham, &c.

sympathetic pains is their recurrence depending on the process of digestion.

I have been seeking for a case,—I think in Portal,—which made an impression on me in my earlier studies. It was a distortion of the spine, in which the point of the lower rib pressed upon the intestine, producing pain in the lower extremity, not constant but intermitting, and depending on the fulness and rising of the gut against the point of the rib. I imagine that, in some instances, the recurrence of pain proceeds, not from the periodical revolution of the system, to which physicians attribute the intermission and exacerbations of fever, but to the stage of digestion and the part of the intestinal canal then under action.

Mr Abernethy speaks of his examinations after death, and discovering that the intestines were subject to partial inflammation : “ the villous coat was found swollen, pulpy, turgid with blood, and apparently inflamed.” His object was to shew, how general irritation may fall on the intestine, producing disordered action elsewhere. I take this as an established fact, and draw an inference from it.

When Sir Astley Cooper lectured before the College of Surgeons, he exhibited the intestines of a dog, which had been fed some hours before. The chyle was exhibited adhering to the surface of the

jejunum, and the corresponding mucous coat in a high state of vascularity. This was the excitement of a part during the performance of its natural function ; and but for that consideration, we should have called it inflammation.

My reader will draw the just inference. In the progress of assimilation of food, distinct parts of the intestinal canal are brought successively into action ; it has also to be recollected, that this canal is estimated to be in length seven times the height of the body. Is it, then, an extravagant conclusion, that a morbid condition, or irritation, or functional disturbance, may take place in this canal, causing pains of remote parts, and that they shall vary according to the part of the mucous membrane under disturbance ?

These considerations bring me to my subject ; which is the effect of purgatives in curing remote and irregular neuralgic pains.

Turn how we may, we find the recommendation universal, of evacuants or purgatives for such disorders. Still the question is ; Is the rationale correct ? We find by the terms used, that the evacuation of offensive matter is the general idea. *Vitiosa primarum viarum—colluvies—sordes—saburra vitiosa*, are terms in common use, and the object seems to be the mere evacuation of the canals, or the removal

of what clings to their interior, such as we see in a foulness of the tongue.

In the first place, we must recollect that the abdominal viscera are not merely incidentally collected and grouped. They are not allied by mere juxtaposition, but are as intimately bound together by nervous relations as the heart and lungs in the thorax, or the brain and the organs of the senses.

There is no disorder of stomach or bowels strictly local or limited. The various secretions which are poured into the canal, into the stomach, or duodenum, are furnished under the influence of the canal, and are as necessarily deranged as the action of the bowels themselves, when under irritation. The mere evacuation of the bowels appears to remove many disorders ; but evacuation implies not only the muscular action of the canal, but vascular excitement, and the pouring out of secretions from the mucous surface ; and more than that, from the subservient glandular viscera. Such a view implies purging into the intestinal canal : the relief to secretions which are pent up. If we look to cases,—and more especially those which are called *Nervous Affections*—the cure has been preceded in many of them, not merely by the discharge of the bowels, but by dark and fetid evacuations, in quantities to make the practitioner express his surprise from whence it came.

These are attended with a subsidence of the tension of the upper part of the abdomen, and relief of sensations, difficult to express, in the præcordia.

Such are the considerations which impose upon the physician the use of certain medicines, which we may call alteratives, or what we please,—but, essentially, they are those which operate on the secreting organs,—those which pour their contents into the intestinal canal. Then it is, that free evacuations, by purgatives, have such surprising effects as authors delight to dwell upon.

Mr Abernethy's practice of administering blue pill, combined with bitter aperient, was happily conceived and illustrated. When I went first to London, I was surprised that it should make so great an impression by its novelty, seeing it was so near the practice acted upon extensively in Scotland, under the recommendation of Dr Plummer.* The use of small doses of emetics and of purgatives,† or the combination of the oxysulphuret of antimony and guaicum with calomel, joined to the diet drink, being so well known among us, it surprised me to find the *town* taken as with a new discovery. But Mr Abernethy put his practice on true pathological

* On Alterative Mercurial Medicine. By Professor Plummer. (Med. Essays of Edinburgh, vol. i. p. 42.)

† Ibid. vol. v. p. 62.

principles, when he said, “ I think it probable that the profuse discharge which sometimes follows the continued exhibition of purgatives, consists of morbid secretions from the bowels themselves, and not the residue of alimentary matter detained.”

The action of a vomit is not the mere evacuation of the stomach, but the diaphragm and abdominal muscles, indeed, the whole class of respiratory muscles, from the groin to the glottis, are highly excited and in action ; the abdominal viscera are compressed and agitated, and the secretions are poured out. Hence, surely, it is, that a vomit acts so surprisingly in the removal of many complaints.*

Even the mere excitement of secretion, by smaller doses, which do not bring the muscular system into action, has powerful influence.†

In regard to the intestines, also, I need hardly point out here, that the canal cannot be excited without an increase of activity in the whole extensive arterial system of the abdomen ; that the blood is consequently urged forwards in all the branches leading to the vena portæ ; that the blood thus urged into the liver must as certainly excite to the secretion of bile, as the increase of respiration excites the lungs

* Hoffmann de motu ventriculi convulsivo sive vomitu. Fothergill Dissert. de Emeticorum usu.

† Med. Essays of Edin. vol. v. p. 75 ; *ibid.* p. 162.

and heart; that by the pouring of bile into the intestines, as their natural purgative, the circle of relations is completed; the action and reaction that take place when the bowels are stimulated.

If this view be correct, it is imperfectly conveyed in the valuable work of the late Dr Hamilton. There is too much said of “fæculent accumulation,”—there is something too mechanical in the notion, that in females the hinderance to effectual evacuation is in the form of the pelvis [p. 138]; yet, practically, it comes to the same thing, since he persevered in the use of purgation until the whole abdominal system was in due activity.

With respect to these neuralgic pains, circumstances have impressed upon me the belief, that the true *tic*, though remotely seated in the branches of the fifth nerve, has its source in the intestinal canal.

I do not offer the croton oil as a specific in this complaint; but its effects have been so remarkable, as to afford a ground of argument. I ordered it at first in desperate circumstances in the most severe case of pain in the cheek; and the effect being immediate, the relief perfect and permanent, I should have been to blame had I not followed the practice in similar cases. In very many it had the same happy result.

What then, I may ask, would be the conclusion

of any inquiring mind, when he found a peculiar purgative acting powerfully, but not more powerfully than other forms previously given, attended with immediate and permanent relief of symptoms? Mine, I confess was, that it acted directly on that portion of the canal, the irritation of which, or as Mr Abernethy would have said,—“the discontented state of which” produced the remote pain.

I have referred to a patient who had been subject to *tic douloureux*, and who had been more than once cured of his pain by croton oil, having died last autumn. There was no disease in the nerve, but ulceration was found in the mucous coat of the ilium. But then it is said in the report conveyed to me, that he had been too powerfully dosed with this medicine. I take the facts either way; the ulceration was the cause of the *tic*, or the ulceration was occasioned by the medicine. In this last supposition, we have the important admission, that croton oil improperly used, will act on a portion of the mucous coat to the formation of ulcer. Could we depend on this reasoning, it would explain how the better regulated administration of the medicine did, in very many cases, affect a portion of the intestine to the removal of morbid irritation there.

Reviewing my experience, I think I am borne out in believing, that the disturbed function of particu-

lar parts of the intestinal canal gives rise to pains differing in their apparent places according to the portion of the canal irritated. Here I conceive there is a wide field for inquiry. If the intestinal canal is estimated at seven times the length of the body ; and if it be also acknowledged, that the different portions of this long tract of mucous membrane perform distinct offices, and are subject to different influences, there is nothing to repel the idea, that those portions being in a condition of disturbance and irritation, shall produce a variety of symptoms, especially differing in their apparent locality.

And this view is countenanced by the effect of medicine. We can throw the influence of evacuants on the different portions of the canal,—affect the stomach, the duodenum, the long intestine, the colon, or the rectum. Thus is each portion of the intestine proved to be distinct in office, and to possess distinct affinities.

It is on this principle that we ought to pursue the inquiry,—*first*, on what part of the extended canal does this secret disturbance fall ; and, *secondly*, what form or combination of medicine shall especially touch or influence the part affected. We have an instance in the effect of the croton oil. Let

us not call it a specific, but seek for other remedies, on a just and scientific principle.*

* Some of my pupils have been very successful in using the croton oil.

Dr Newbigging junior, gives a short paper in the Edinburgh Medical and Surgical Journal, No. CXLVI., on the croton oil employed in nervous affections with remarkable success.

Note.—Looking back to my successful cases, I have never found it necessary to give more than $\frac{1}{12}$ of a drop in combination. Others, by administering oil not genuine at one time, and an over-dose of true croton at another, have done great mischief.

THE END.



